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ABSTRACT

This teaching guide accompanies "The Environmental Data Book," published by the World Bank. Environmental and development statistics are presented for discussion and analysis. Indicators of environmental quality and economic development are defined with accompanying charts and maps. Activities accompany each lesson, along with a worksheet at the end of each chapter to consolidate and measure learning for that indicator. Sections of the guide include: (1) "Introduction"; (2) "Beginning Activities"; (3) "Water: Access to Safe Water"; (4) "Land: Change in Forest Area"; (5) "Air: Suspended Particulate Matter"; (6) "Atmosphere: Carbon Dioxide Emissions per Capita"; (7) "Culminating Activities"; (8) "Test"; and (9) "Outline Maps." (EH)

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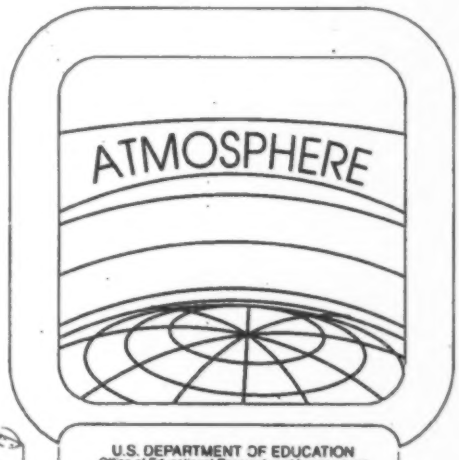
TEACHING GUIDE
for
The Environmental Data Book
A Guide to Statistics on the Environment and Development



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Teaching Guide for

The Environmental Data Book

The World Bank
Washington, D.C.

What Is the World Bank?

The World Bank—which includes the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA)—is an international institution owned by the governments of more than 170 countries. Its purpose is to help its developing member countries improve economic and social conditions so that their people may live better and fuller lives. It does this by lending money to governments. Most of the money is used for development projects. These projects might help countries increase agricultural productivity; provide basic health care; train teachers; build roads, power stations, schools, and health clinics; modernize industries; expand telecommunications networks; or construct water and sewerage facilities. The World Bank also helps governments undertake economic policy reforms, provides advice and technical assistance, and serves as a catalyst to stimulate investment and lending by others. IBRD loans are generally less expensive than commercial bank loans and have longer repayment periods. IDA loans—which are made to the Bank's poorest member countries—are interest-free and have even longer repayment periods. The IBRD was established in 1944; IDA was founded in 1960. Together their loans to developing countries now amount to about $20 billion a year.

Introduction

This teaching guide accompanies *The Environmental Data Book: A Guide to Statistics on the Environment and Development*. The learning activities it presents are designed for students who are studying environmental issues, economics, geography, international studies, or world history.

Point of View

The point of view of *The Environmental Data Book* and the teaching guide is as follows:

- All countries, rich and poor, face environmental problems that are often closely linked with efforts to reduce global poverty and improve people's standard of living.
- The relationship between economic development and the environment is complex, and reliable information and data are often scarce.
- Rising economic activity can both cause environmental problems and, with the right policies and institutions, help solve them.
- Because the world is becoming increasingly interdependent, meeting the needs of people today without jeopardizing our ability to meet the needs of future generations is an issue that affects all people in all countries.

Goals, Objectives, and Evaluation

The Environmental Data Book and teaching guide have 2 main goals:

- To increase students' knowledge and understanding of the relationship between economic development and the environment.
- To strengthen students' abilities to perform statistical calculations; to make and interpret maps, charts, and tables; to analyze and synthesize information; to make inferences and generalizations; and to think critically when solving problems and making decisions.

As a result of using *The Environmental Data Book* and teaching guide, students should be able to do the following:

- Recognize basic areas of environmental concern that affect people in all countries.
- Compare and contrast environmental conditions in developing and industrial countries.
- Show an understanding of the relationships between:
  - access to clean water, life expectancy, and gross national product (GNP) per capita
  - loss of forests, standard of living, and GNP per capita
  - air pollution, health, technology, and GNP per capita
  - carbon dioxide emissions per capita, energy use per capita, and GNP per capita
- Make inferences from statistics about environmental conditions, living conditions, and levels of economic development.
- Express opinions about environmental conditions in industrial and developing countries and use statistics to support them.

A test to measure the achievement of these objectives is included in this teaching guide.

Using *The Environmental Data Book* and This Teaching Guide

The teaching activities for each of the 4 units follow a consistent approach.

- Begin each unit in the student book by discussing the definition of the indicator. Continue with the map, the text, and the charts. Then move to the skill-building activities for using the data table.
- Activities in the teaching guide are not organized by increasing complexity. Activities marked with a blue asterisk [*] are for highly motivated students and those with greater knowledge of statistics and developing countries.
- After teaching each unit, have students complete the worksheet for that unit to help consolidate and measure what they have learned.
- If possible, students should use calculators when working with the data.
- The blank comparative data table is designed so that, in most cases, space is available for students to add more data if you wish to have them do so.
- When making maps, students may ignore the small countries that are difficult to show.
- Information for teachers is printed in blue and will not photocopy.

Beginning Activities

[Encourage students to complete these exercises in order to maximize the learning experience.]

What Is This Book About?

Look over *The Environmental Data Book* to get an idea of its content and format. Study the artwork on the cover. What does it show? Read the "Introduction" and "What Is the World Bank?" on the inside front cover. Turn to the "Definitions and Notes" on page 15 and read the definitions of *developing countries, low-income countries, middle-income countries, high-income developing countries,* and *industrial countries.* Now discuss these questions.

1. What do we mean when we say "the environment"? [Answers will vary but should include the complex system of air, water, plants, and animals that are essential to survival of life on earth.]

2. What does "economic development" mean? [improving people's standard of living; increasing the number of goods and services available to people]

3. Why must people be careful when using statistics? [They may not be accurate or up-to-date.]

4. Who published *The Environmental Data Book*? [The World Bank]

5. What would you expect the publisher's point of view to be? [Possible answer: Developing countries can strengthen their economies and improve the standard of living of their people, and industrial countries can help in this process.]

6. In your opinion, what are the 3 most important environmental issues facing people in the world today? [You might save students' answers for reference when doing question 5 under "Culminating Activities."]

How Are Countries Grouped?

1. *The Environmental Data Book* gives data for all countries with populations of 1 million or more. These countries—128 in all—are grouped into 6 geographic regions, which are listed in Data Table 1 on pages 10-13. What are the 6 regions? [North and Central America and the Caribbean; South America; Europe; the Middle East and North Africa; Sub-Saharan Africa; Asia and the Pacific]

2. Look again at Data Table 1. The 128 countries are organized into 3 main economic groups: low-income countries, middle-income countries, and industrial countries.

a. What is the difference between these groups? [In low-income countries, most people cannot meet their basic needs for food, clothing, shelter, and jobs. In middle-income countries, many people cannot meet their basic needs. In industrial countries, most people are able to meet their basic needs.]

b. How many countries are there in each group? [low-income countries, 43; middle-income countries, 58; industrial countries, 19]

c. Which economic group is your country in?

3. Notice that 8 countries in Data Table 1 are not included in the 3 main economic groups. Which countries are they and how are they classified? [Cuba, the People's Democratic Republic of Korea, and the former USSR are nonmember countries. Hong Kong, Israel, Kuwait, Singapore, and the United Arab Emirates are high-income developing countries.]

Notice also that *The Environmental Data Book* gives statistics for the former Czechoslovakia, USSR, and Yugoslavia. This is because the data are for years when these countries still existed.

Where in the World Is It?

[Give students copies of all outline maps in the back of the teaching guide.]

1. Using the blank outline map of the world, draw boundary lines for each of the 6 geographic regions listed in Data Table 1 and label each one. Now locate each industrial country listed in the data table and shade it in with your pencil. (If you need help finding a country, look at the labeled outline map of the world.)

2. Using the 4 regional outline maps and Data Table 1, write the name of each low-income country with red pen or pencil. Next write the name of each middle-income country with blue pen or pencil. Now use your pencil to mark "H" on the high-income developing countries and "N" on the non-member countries. (If you need help finding a country, look at the labeled outline map of the world.)

3. Look at the maps you have made.

a. In which regions do industrial countries tend to be located? [North and Central America and the Caribbean; Europe]

b. In which regions do low-income countries tend to be located? [Asia and the Pacific; Sub-Saharan Africa]

c. In which regions do middle-income countries tend to be located? [Asia and the Pacific; North and Central America and the Caribbean; South America]

d. In which regions are high-income developing countries located? [Asia and the Pacific; the Middle East and North Africa]

What Do the Data Tables Show?

1. Look at Data Table 1.

a. How many different statistical indicators are there? [17]

b. The statistical indicators can be divided into 3 main categories of data: social, economic, and environmental. Give 2 examples each of a social indicator, an economic indicator, and an environmental indicator. [For example: social indicators—population, life expectancy at birth; economic indicators—GNP per capita, average annual growth of GNP per capita; environmental indicators—access to safe water, change in forest and woodland]

c. Give an example of an indicator that may fit into more than one category of data. [For example: Population per passenger car and energy use per capita can indicate both environmental and economic conditions.]

2. Look at Data Table 2 on page 14.

a. What 2 broad types of air quality indicators does the table show? [suspended particulate matter and sulfur dioxide] Are these social, economic, or environmental indicators? [environmental]

b. Does the data table focus on countries or cities? [cities]

c. How many of these cities are in industrial countries? [18 (cities in Australia, Belgium, Canada, Denmark, Finland, Germany, Japan, and the United States)]

Water: Access to Safe Water

(pages 2–3 of *The Environmental Data Book*)

Definition of Indicator

Access to safe water is measured by the number of people who have a reasonable means of getting clean water, expressed as a percentage of the total population. It reflects the health of a country's people and the country's ability to collect, clean, and distribute water.

Key Points

- Rates of access to safe water are higher in industrial countries than in most developing (low- and middle-income) countries.
- 3 million people, mostly children, die each year from diarrheal illness caused by unsafe water. Millions more suffer from other water-related illnesses. Poor people tend to be most at risk.
- 1.7 billion people in developing countries (1 out of every 3 people in the world) lack access to adequate sanitation, and of these, 1 billion lack access to safe water.
- The situation is improving generally, but problems remain. In rural areas, people without access to sanitation still outnumber those with access. In urban areas, because populations are growing rapidly, the number of people without access is increasing, even though the percentage is decreasing.
- As a country's economy becomes stronger—as its GNP per capita rises—a larger percentage of its people tend to have access to safe water and sanitation.
- Safe water is scarce because it is often undervalued and used inefficiently.

Understanding the Indicator

1. Read the definition of *access to safe water* at the top of page 2 in *The Environmental Data Book*.

a. What does this indicator measure? [the number of people who have a reasonable means of getting clean water, expressed as a percentage of the total population]

b. Look up *access to safe water* in "Definitions and Notes" at the back of *The Environmental Data Book*. How is "reasonable" access defined? [In urban areas, there is a public fountain or water spigot within 200 meters of the household. In rural areas, members of the household do not have to spend excessive time each day fetching water.] What would you consider a reasonable amount of time to spend each day getting water?

c. Why do people need safe water? [Possible answers: to survive; to stay healthy]

d. What do you think social and economic conditions might be like in a country where relatively few people have access to safe water? [Possible answers: Many people are probably poor; disease is probably common; many people probably die young.]

2. Make a list of all the ways in which we use water. [Possible answers: for drinking; for bathing; for washing clothes and dishes; for cleaning; for cooking; for watering crops and livestock; for waste disposal; as a source of power; as a solvent; as an ingredient in various products; as a coolant; as a source of recreation]

a. For which uses is it most important to have safe water? [drinking; bathing; washing dishes]

b. Which uses are likely to pollute water? [washing; waste disposal; industrial uses; farming, because water runoff may contain pesticides, fertilizer, or animal waste]

3. How do people in your community get water? [Possible answers: from taps; from wells] What kinds of costs are involved? [For piped water: money for pipes, storage tanks, chemicals for treatment, people to oversee the work of supplying the water. For wells: pumps, electricity, cleaning, maintenance.]

Interpreting the Map

1. Study Map 1 on page 3 of *The Environmental Data Book*.

a. Which color on the map represents countries with the lowest percentages of people with access to safe water? [yellow] The highest? [dark green]

b. Which region of the world has the lowest percentage of people with access to safe water? [Sub-Saharan Africa] The next lowest? [Asia and the Pacific] What assumptions can you make about living conditions in these areas? [Possible answer: Many people are probably poor and often sick.]

2. Using Data Table 1 at the back of *The Environmental Data Book*, make a list of 5 industrial countries. Next to each name, write which color the country is on Map 1. List only countries for which data are available. Do the same for 5 middle-income countries and 5 low-income countries. Use your lists and the map key to answer the following.

a. Which group of countries, taken together, has the highest access to safe water? [industrial] The lowest access to safe water? [low-income]

b. To get a larger data base, compare your answers with those of your classmates. Were their findings the same as yours?

c. Make a general statement about the relationship between a country's economy and access to safe water in that country. [Possible answer: The richer a country is, the more likely the people are to have access to safe water.]

Understanding the Text

Read the text on page 2.

1. How many people die each year from diarrheal diseases related to dirty water? [3 million] Are most of these people adults or children? [children] Why do you think this is the case? [Possible answer: Children have less resistance to disease.]

2. What is the main contaminant of water? [human wastes] How can this kind of contamination be minimized? [basic drainage and sewerage systems] What other kinds of contamination are there? [industrial and agricultural wastes] How do you think these kinds of contamination might be reduced? [Possible answers: cleaner methods of production that generate less pollution and waste; safer methods of waste disposal; more careful use of fertilizers and pesticides] Look up *sanitation* in "Definitions and Notes" at the back of the book. What 3 steps are involved in providing people with adequate sanitation? [collect waste water, clean it, and redistribute it]

3. Find examples from the text that show how a lack of safe water affects people's health, productivity, and quality of life. [Health: causes illnesses and deaths. Productivity: can slow factory production, reduce crop yields, destroy fisheries. Quality of life: costs time and money; causes environmental degradation.]

4. Give 2 facts from the text to support this statement: "The poorest people suffer the most from a lack of safe water." [The urban poor must buy vended water, which is more expensive than piped water. The rural poor must spend a lot of time hauling water.] Why else might the poor suffer most? [Possible answer: They cannot afford to pay for medical care if they become ill.]

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Understanding Chart 1

1. Study Chart 1, which shows world population and access to safe water and sanitation for developing and industrial countries. (Cuba, the People's Democratic Republic of Korea, and the former USSR are listed as "Other" because the World Bank has only limited data for them.)

a. How many people are there in the world? [more than 5.3 billion] How many are there in developing countries? [4.2 billion] What percentage of the world population do they account for? (Divide 4.2 billion by 5.3 billion and multiply by 100.) [79%]

b. If 1 billion of the people in developing countries do not have access to safe water, how many do? [3.2 billion] What percentage is this? [76%] What percentage do *not* have safe water? [24%] What percentage have adequate sanitation? [60%] What percentage do not? [40%]

c. How does the number of people without sanitation in developing countries compare with the total population of industrial countries? [more than double] Why do you suppose the number of people without sanitation is greater than the number of people without safe water? [Possible answer: Some people without sewerage and drainage may have access to spring water or well water that is clean.]

2. In the year 2000, the population of developing countries is expected to reach almost 5 billion. If the number of people in those countries with access to safe water stays the same as it was in 1990, what percentage of the population will have access to safe water in 2000? [3.2 billion ÷ 5.0 billion x 100 = 64%] How does this compare with the percentage you calculated for 1990 in question 1(b)? [It is less.] Would the population in 2000 be better off, worse off, or the same? Explain. [worse off, because the percentage of the population with safe water will have gone down]

Understanding Chart 2

Study Chart 2, which shows access to adequate sanitation in rural and urban areas of developing countries in 1980 and 1990. The number above each bar tells you the *percentage* of the total rural or urban population with or without access in a given year. The height of each bar tells you the *number* of people with or without access in that year.

1. Look at the data for 1980.

a. Did more people live in rural or urban areas? [rural]

b. Did most people in rural areas have access to adequate sanitation? [no] What about people in urban areas? [yes]

c. In terms of water supply in 1980, would you have been better off living on a farm or in a city? Why? [in the city, because you have a 67% chance of having adequate sanitation versus only a 36% chance in rural areas]

2. Look at the data for 1990.

a. Did more people live in rural or urban areas? [rural]

b. Did most people in rural areas have access to adequate sanitation? [no] What about people in urban areas? [yes]

c. In terms of water supply in 1990, would you have been better off living on a farm or in a city? Why? [in the city, because you have a 71% chance of having adequate sanitation versus only a 48% chance in rural areas]

3. Look at the data for both 1980 and 1990.

a. In rural areas between 1980 and 1990, did the *percentage* of people with access to adequate sanitation increase or decrease? [increased, from 36% to 48%] What about the *number* of people? [increased, from 0.8 billion to 1.3 billion]

b. In urban areas between 1980 and 1990, did the *percentage* of people with access to adequate sanitation increase or decrease? [increased, from 67% to 71%] What about the *number* of people? [increased, from 0.6 billion to 0.9 billion]

c. Numbers alone do not always tell the whole story. Look again at the data for urban areas. In 1990 more people had adequate access to sanitation than in 1980, but because the urban population grew overall, there were also more people *without* access. How can you tell whether any progress was made? [If you consider the *percentage* of the population with and without access, rather than the *numbers* of people, you see that conditions did improve. There were 4% more people with adequate access in 1990, and 4% fewer people without access.]

4. What kinds of problems might make it difficult to provide safe water and sanitation to people in urban areas where populations are growing rapidly? [Possible answers: too many people needing too many services too quickly; lack of money, materials, expertise, and skilled workers to build more sewers, pipes, and treatment plants; lack of public awareness of the importance of safe water and adequate sanitation]

***5.** Statistics can be powerful tools that help us understand our world. But statistics must be used carefully, and people must understand what the data do and do not tell us.

You are running for reelection after 2 five-year terms as president of a country of 4 million people. Assume that all the statistics related to population growth and adequate sanitation for your country are the same as in Chart 2 (page 2 of *The Environmental Data Book*), except that the numbers refer to millions, not billions. You want voters to know what progress your country has made since you have been president.

a. What can you say to urban voters? [Possible answer: "Since I took office, more than 300,000 people in our cities now have sanitation who didn't have it before."]
b. What might your opponent say to urban voters? [Possible answer: "In our cities, 400,000 people don't have adequate sanitation. In fact, the number of urban people without adequate sanitation has gone up in the past 10 years."]
c. What can you say to rural voters? [Possible answer: "Since I took office, almost half a million more people now have sanitation."]
d. What might your opponent say to rural voters? [Possible answer: "In rural areas, 1.4 million people are still without adequate sanitation. Those who don't have sanitation outnumber those who do."]
e. What can happen if statistics are not used carefully? [They can distort the facts.]

*For highly motivated students and those with greater knowledge of statistics and developing countries.

Understanding Chart 3

1. Read about *life expectancy* in "Definitions and Notes" at the back of *The Environmental Data Book*. From your experience, what are some things that can affect life expectancy? [Possible answers: illness, violence, natural disasters, nutrition, access to medical care, smoking and drinking, hazardous work]

2. Study Chart 3, which suggests a relationship between life expectancy and improvements in water supply and sanitation in 3 French cities from 1820 to 1900.

a. What was life expectancy in each city in 1820? [32 years] What was life expectancy in each city in 1900? [Lyons, 50; Paris, 45; Marseilles, 41] What was the general trend for all 3 cities? [increased life expectancy]
b. In what year did life expectancy start to rise in each city? [Lyons, 1852 or so; Paris, 1855; Marseilles, 1886]
c. Why do you think life expectancy was higher in Lyons in 1900 than in Paris or Marseilles? [Lyons improved water supply and sanitation earlier.]
d. According to Chart 3, life expectancy in Marseilles began improving even before water and sanitation did. What are some possible explanations for this? [Possible answers: medical advances, better nutrition, increased awareness of basic hygiene]

3. You are a government official in a country in Latin America. A crisis exists in your country because an epidemic of cholera has broken out and is spreading rapidly. You are holding an emergency meeting with other officials to decide what to do. As you plan your course of action, consider the following.

- Cholera is spread by fecal contamination of food and water.
- Victims become extremely thirsty and need lots of water or they will die from dehydration.

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- Hospitals are overcrowded in your country even when there is no epidemic.
- Households can boil their drinking water for 10 minutes to make it safe. But most people are not aware of this, and, even if they were, it would cost the average poor family a third of its income to do so.
- Tourism has disappeared, and other countries will no longer buy fruits and vegetables grown in your country.

What actions would you take immediately? What policies would you set up for the long run? How would you pay for these measures?

Using Data Table 1

[The blank comparative data table at the back of this teaching guide may be photocopied for these exercises.]

1. Make a table comparing selected indicators in 4 developing countries from 4 different regions of the world. Get a blank comparative data table and title it "Access to Safe Water and Other Indicators, 1990." Follow these steps.

a. Down the left side of the table under the heading "Country," list the following: Brazil, China, Morocco, and Nigeria.
b. At the top of column 1, write the heading "Region." Then, in the squares below, fill in the appropriate region for each country. [Brazil—South America; China—Asia and the Pacific; Morocco—the Middle East and North Africa; Nigeria—Sub-Saharan Africa]
c. In column 2 at the top of the table, write the heading "Access to safe water (percent)."
d. Using Data Table 1 at the back of *The Environmental Data Book*, fill in the percentage of access to safe water in 1990 for each country.
e. Rank the countries, with "1" equaling the highest access to safe water and "4" the lowest. Write the appropriate ranking number in parentheses after the data in column 2. [Brazil, 1; China, 2; Morocco, 3; Nigeria, 4]
f. Make a general statement comparing the 4 countries. [Possible answer: Brazil has the largest percentage of population with access to safe water; Nigeria has the smallest.]
g. Save your table for later use.

2. Find Brazil, China, Morocco, and Nigeria on Map 1 on page 3 of *The Environmental Data Book*. Compare the color of each country with those of its neighbors. To what extent is each country typical of conditions in its area and region? [Brazil, China, and Nigeria are fairly typical; Morocco is less typical.] Make a general statement comparing the 4 regions. [Possible answer: People in Sub-Saharan Africa and in Asia and the Pacific tend to have less access to safe water than people in the Middle East and North Africa and in South America.]

3. In "Definitions and Notes" at the back of *The Environmental Data Book*, read about *infant mortality rate* and *GNP per capita*. Using the data table you prepared in exercise 1 above, do the following.

a. Write "Life expectancy (years)" at the top of column 3 of your data table, "Infant mortality rate (per 1,000 live births)" at the top of column 4, and "GNP per capita (US dollars)" at the top of column 5.
b. Use Data Table 1 to fill in the information for each country.
c. Rank the countries for each indicator, with "1" equaling the highest life expectancy, lowest infant mortality rate, and highest GNP per capita and "4" equaling the lowest life expectancy, highest infant mortality rate, and lowest GNP per capita. Write the appropriate ranking number in parentheses after the data in each column.
d. Based on these rankings, how do the 4 countries compare with one another? [In general, conditions tend to be better in Brazil and China than in Morocco and Nigeria.]
e. To what extent do the results confirm the link between water conditions and health shown in Chart 3? [There is a high correlation. Brazil and China not only have higher rates of access to safe water than Morocco and Nigeria, but also longer life expectancies and lower infant mortality rates.]

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Thinking about the Issues

1. You are the prime minister of a low-income country with a population of 22 million. Sixty percent of the population lives in rural areas; most of the rest live in the capital city. Experts say that in 10 years more than half the population will live in the cities.

Your country faces many problems. One of the most serious is that 17 million people lack adequate sanitation and 15 million of these also lack access to safe water. As a result, thousands of people, mostly children, die each year. Listed below are some activities that may help improve access to safe water and sanitation in your country. The government has $350 million to spend in the coming year. Choose the 6 activities you would undertake first and explain why.

a. Set up a team of experts to monitor the quality of the drinking water in wells, lakes, and rivers in rural areas throughout the country. (Cost: $500,000)
b. Establish a Water Supply Board that will charge households, farmers, and industries the full cost of the water they use and will collect these fees. (Cost: $1,500,000)
c. Expand the system of water pipes in urban areas so that even the poorest people have a faucet within 500 feet of their homes. (Cost: $2,000,000)
d. Set up a team of experts to monitor the quality of the drinking water in urban areas throughout the country. (Cost: $350,000)
e. Give tax breaks to those who dig their own wells to supply their own water. (Cost: $2,225,000)
f. Run a media campaign using billboards, radio, television, and newspapers to teach parents how best to care for their children if they get sick from the unsafe water. (Cost: $350,000)
g. Give the poorest people special vouchers that can be used as money to buy safe water or fuel for boiling the water they have. (Cost: $150,000,000)
h. Repair existing water and sewer pipes in urban areas so that clean water is not wasted and dirty water can be safely carried away. (Cost: $1,000,000)
i. Make laws that force factories to stop dumping their untreated waste water into rivers and lakes, and establish a team of inspectors to enforce the laws. (Cost: $2,000,000)
j. Build 2 large sewerage treatment plants for the capital city. (Cost: $250,000,000)
k. Create 5 mobile health teams that will travel around the country teaching people about better hygiene, how to make their drinking water safer, and how to care for people, especially children, who get sick from dirty water. (Cost: $1,500,000)

2. Find Bangladesh, Nigeria, and Trinidad and Tobago on a world map. In Bangladesh, the poorest people spend 11 percent of their household income on fuel to boil their drinking water. In the urban slums of Nigeria, people pay 18 percent of their household income for water. In Port of Spain, the capital of Trinidad and Tobago, the poorest people pay 20 percent of their household income for water.

a. What would these percentages amount to for a family making $40,000 a year? [$4,400 in Bangladesh; $7,200 in Nigeria; $8,000 in Port of Spain]
b. Find out what the average water bill and average household income are in your community. Calculate the water bill as a percentage of income. How does it compare?

3. You live on a farm in a low-income country, and the only source of water for you, your spouse, and your 4 small children is a pond. You have 2 cows, 4 goats, and 10 chickens. It is your responsibility to fetch the water. It takes you half an hour to carry 4 gallons of water from the pond to your farm, and you have only enough time to make 2 round trips each day.

On an average day, how much of the water you carried would you and your family use for each of the following activities? (You may have decided to do some of these activities at the pond.)

- drinking
- cooking
- watering the livestock
- watering a 15- by 20-foot vegetable garden
- washing hands
- bathing
- washing dishes
- washing clothes

Name _____

Date _____

Worksheet 1: Access to Safe Water

Answer these questions in the space provided or on the back of this sheet of paper. For multiple-choice questions, circle the letter of the correct answer.

1. Access to safe water is measured by
   a. the number of people with access to a safe supply of piped water.
   b. the percentage of the population with a reasonable means of getting safe water. [x]
   c. the rate at which the population increases its access to safe water.

2. Which of these statistics is true?
   a. Three out of 5 people in the world live in developing countries.
   b. In developing countries in 1990, 1 billion people were without access to safe water and 1.7 billion were without access to adequate sanitation. [x]
   c. Both of the above.

3. The percentage of people with access to safe water is lowest in
   a. Sub-Saharan Africa. [x]
   b. Asia and the Pacific.
   c. South America.

4. Which of the following is true?
   a. The number of people without access to adequate sanitation is increasing in both urban and rural areas.
   b. The majority of people in both urban and rural areas have access to adequate sanitation.
   c. The percentage of the population with access to adequate sanitation is increasing in both urban and rural areas. [x]

5. As a country's rate of access to safe water improves,
   a. life expectancy and infant mortality tend to increase.
   b. life expectancy tends to increase and infant mortality tends to decrease. [x]
   c. life expectancy and infant mortality tend to decrease.

6. Water is a
   a. renewable resource. [x]
   b. nonrenewable resource.

7. How does rapid population growth affect the rate of access to safe water? [It makes it harder to maintain or improve the rate, unless there is corresponding growth in water and sanitation services.]

8. Why do people in industrial countries have higher rates of access to safe water than people in most developing countries? [Industrial countries generally have more money to build water distribution systems and to collect and treat sewage.]

9. What are the advantages and disadvantages of families in developing countries boiling water to make it safe? [Advantages: People, especially children, are less likely to get sick or die from water-related diseases. Disadvantages: It causes people to use more fuelwood, which depletes the forests and causes indoor air pollution.]

10. Why is safe water often scarce in developing countries? [People may feel that water is plentiful and cheap; governments may not have the money and expertise to collect, clean, and redistribute water.]

Land: Change in Forest Area

(pages 4–5 of *The Environmental Data Book*)

Definition of the Indicator

Change in forest area is the increase or decrease in forest and woodland during a period of time, usually one year, expressed as a percentage of that area at the start of the period. It reflects the gain or loss of trees, of homeland for indigenous peoples, and of habitat for plants and animals.

Key Points

- Forests enrich and hold the soil, collect and recycle water, help regulate climate, absorb carbon dioxide, and release oxygen.
- In the 1700s and 1800s, industrial countries cleared a third of the world's temperate forests for agriculture, building materials, and fuelwood.
- Forest and woodland are decreasing most rapidly in developing countries, where most tropical moist and dry forests are located. Trees are cut for timber and fuelwood and to clear land for farming, ranching, and mining.
- Forests are a renewable resource that can be protected by government laws and policies.

Note: The world's original forest area (about 6 billion hectares) has been declining steadily throughout human history, with about one-third of the forests lost in the past few hundred years.

Understanding the Indicator

Notice that the percentage of change in forest area can be either a positive number, reflecting an *increase* in forest area, or a negative number, reflecting a *decrease* in forest area.

1. Read the definition of *change in forest area* at the top of page 4 in *The Environmental Data Book*.

a. What does this indicator measure? [the increase or decrease in forest and woodland area during a period of time, usually one year, expressed as a percentage of that area at the start of the period]

b. What would a negative number indicate? [loss of forest area] What would a positive number indicate? [gain of forest area]

c. What does the indicator tell you about a country? [the rate at which trees, homeland, and habitat are being gained or lost]

d. Does it tell you the amount of forest area a country has? [no]

e. From your own experience, why are trees important? [Possible answers: They provide lumber, food, shade, and shelter; they offer beauty.]

f. Why do people cut trees? [Possible answers: to get fuelwood or lumber; to clear land for buildings, farms, towns, and roads]

g. Think about your everyday life. Give examples of some of the things that you have and use that are made from trees. Choose 1 or 2 of your examples and find out what kinds of trees were used to make them, where those trees grow, and whether or not the supply of those trees is being used up.

2. Fill in the table below to show how much forest and woodland area was gained or lost in countries A, B, and C from 1991 to 1992, and what the percentage of change was. (To calculate the change, take the area gained or lost, divide by the 1991 area, then multiply by 100 to convert the decimal to a percentage, and round to the nearest tenth of a percent. Remember to express gains with positive numbers and losses with negative numbers.)

Country	(1) *Forest and woodland, 1991 (thou. of sq. km.)*	(2) *Forest and woodland, 1992 (thou. of sq. km.)*	(3) *Area gained/ lost (thou. of sq. km.)*	(4) *Change in forest and woodland (percent)*
A	706	755	[49]	[6.9]
B	4,927	4,794	[−133]	[−2.7]
C	1,389	1,364	[−25]	[−1.8]

Interpreting the Map

Study Map 2 on page 5.

1. Which color represents countries that are gaining forest and woodland? [dark green] Are these countries located on one or on several continents? [several]

2. Which color represents countries that are losing forest and woodland at the fastest rate? [red] In which regions are these countries located? [Sub-Saharan Africa, North and Central America and the Caribbean, South America, Asia and the Pacific]

3. Are there many countries with no change in the amount of forest and woodland? [yes] Does no change mean that no forests are being cut? Explain your answer. [No, it can mean that an equal amount of land is reforested.]

4. What, if any, information on the map surprises you?

5. a. List 5 countries in which the decrease in forest and woodland is 1.1 percent or more, 5 in which the decrease is 0.6 to 1.0 percent, and 5 in which forest and woodland are increasing.

b. Look at Data Table 1 at the back of *The Environmental Data Book*. Find the income group for each country you listed and write it next to the country's name.

c. Which group of countries tends to be losing forest and woodland at the fastest rate?

d. Which group of countries tends to be gaining forest and woodland?

Understanding the Text

Read the text on pages 4–5.

1. How much of the earth's surface is covered in forest? [almost 30%]

2. What are the three basic types of forest? [temperate, tropical moist, tropical dry] Where do tropical forests tend to be located? [in developing countries] Where do temperate forests tend to be located? [in industrial countries]

3. Why are forests important? [They provide homeland for people and habitat for plants and animals; they enrich and hold the soil; they collect and recycle water; they regulate climate; they absorb carbon dioxide and release oxygen.]

4. What happened to the earth's temperate forests in the 1700s and 1800s? [One-third were cut for agriculture, building materials, and fuelwood.]

5. Why might people today decide to plant fast-growing pines in temperate forests to replace slow-growing oaks that have been cut down? [to get more forest faster]

6. What kinds of laws and policies can you think of that would help protect trees and forests? [Possible answers: creating more parks and wildlife refuges; not allowing people to cut trees on public property without paying to replace them; requiring land developers to cut as few trees as possible and to replace the ones they do cut]

Understanding Chart 4

1. What happened to the amount of forest and woodland between 1965 and 1989? [It decreased in all country groups.]

2. What activities account for the greatest loss of trees in tropical moist forests? [ranching and farming, then logging] In tropical dry forests? [cutting fuelwood and clearing land for grazing]

3. In which country income group did the fastest change occur in a given type of land use? [middle-income] Describe this change. [Cropland increased at an average rate of 0.7% a year.]

4. Give examples of the types of land use that would be included in the category "All other." [Possible answers: developed land that is being used for houses, factories, roads, airports, railways, playgrounds, parks, and golf courses; deserts; swamps and marshlands]

Understanding Chart 5

Study Chart 5, which shows the loss of tropical forests in developing regions between 1980 and 1990. With deforestation data, the numbers are positive but they reflect a *decrease* in forest area.

1. Which region had the most forest area in 1980? [Latin America and the Caribbean] The least? [Asia]

2. Which region has lost its forests at the slowest rate? [Sub-Saharan Africa] The fastest? [Asia]

3. On average, how many hectares of tropical forests did Latin America and the Caribbean lose each year? [about 8.3 million]

4. On average, what percentage of its forests did Asia lose each year? [1.2%] Was this above or below the world average? [above]

5. The chart shows that Latin America and the Caribbean lost the most forest area, but Asia lost its forests at a faster rate. In your opinion, is the loss of forest more serious in Asia or in Latin America and the Caribbean? Explain your answer. [Students should discuss the difference between a large percentage applied to a small area and a small percentage applied to a large area.]

6. The table below gives the data for Chart 5. Calculate how much forest area each region had in 1990, and put your answers in column 4. (Multiply the number of hectares deforested per year by the number of years in the period—in this case, 10. Subtract the result from the amount of forest area in 1980. Round your answers to the nearest million.)

Region	(1) *Forest area, 1980 (millions of hectares)*	(2) *Average area deforested per year, 1980–90 (millions of hectares)*	(3) *Average rate of deforestation per year, 1980–90 (percent)*	(4) *Forest area, 1990 (millions of hectares)*
Asia	310.8	3.6	1.2	[275]
Latin America and the Caribbean	923.0	8.3	0.9	[840]
Sub-Saharan Africa	650.3	5.0	0.8	[600]

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7. If these 3 regions of the world continued to lose each year about the same amount of forest shown in Chart 5, approximately how many years would it take before the forests in each region disappeared? (Divide the total forest area in the region in 1990 by the forest area lost each year.) [Asia: 275,000,000 ÷ 3,600,000 = 76 years. Latin America and the Caribbean: 840,000,000 ÷ 8,300,000 = 101 years. Sub-Saharan Africa: 600,000,000 ÷ 5,000,000 = 120 years.]

8. Find your country in Data Table 1 at the back of *The Environmental Data Book*. How much forest area does your country have? Is that amount increasing or decreasing? At what rate? How do the data for your country compare with the data in Chart 5?

Understanding Chart 6

Study Chart 6, which shows logging fees as a percentage of reforestation cost.

1. What is a renewable resource? Give examples. Check your answer with the definition of *renewable* in "Definition and Notes." In your opinion, what are some reasons why renewable resources might be undervalued or taken for granted? [Possible answers: The supply may seem unlimited or be hard to quantify; people may pay little or nothing for resources like clean water and air, and so not appreciate their value.]

2. Can you tell from the chart which country has the highest logging fees? [no] Can you tell which has the highest reforestation costs? [no] Can you tell which is recovering the highest percentage of its reforestation costs? [Yes, Ethiopia.]

3. The exact data for each country are as follows: Niger, 0.6 percent; Sudan, 3.9 percent; Côte d'Ivoire, 13.2 percent; Kenya, 14.4 percent; and Ethiopia, 23.5 percent. What is the average for all 6 countries? (Add the percentages, then divide the total by 6.) [9.6%] Now convert your answer to a fraction to complete this sentence: "The logging fees charged in these countries average out to about [one-tenth] of the cost of planting replacement trees." Of every dollar spent on reforestation, then, about how much is covered by logging fees, on average? [10¢]

4. High logging fees in one country do not necessarily mean lower profits for the logging companies there. Explain why this is so. [Possible answers: High logging fees might be offset by low labor, equipment, and transport costs; the logging companies might be selling their lumber for higher prices than companies elsewhere.]

5. Locate the 6 countries on Map 2 on page 5 in *The Environmental Data Book*. Based on the map, which countries are losing forest fastest? [Niger and Côte d'Ivoire] Which country is staying stable? [Senegal]

Using the Data Table

[The blank comparative data table at the back of this teaching guide may be photocopied for these exercises.]

1. Make a table comparing rates of deforestation among countries with large areas of forest. Get a blank comparative data table and title it "Comparing Deforestation Rates, 1989." Follow these steps.

a. Study column 3 of Data Table 1. Down the left side of your table under the heading "Country," list the 7 countries with the most forest area. [Canada, United States, Brazil, Zaire, Australia, China, Indonesia] How many are industrial countries? [3] How many are developing countries? [4] Find each country on the map. On which continent is each located? [Canada and the United States are in North America; Brazil is in South America; Zaire is in Africa; China and Indonesia are in Asia; Australia is itself a continent.]

b. In column 1 at the top of the table, write the heading "Forest and woodland area (thousands of square kilometers)." Fill in the data for each country.

c. Study column 2 of Data Table 1. In column 2 at the top of your table, write the heading "Change in forest and woodland (annual percentage)." Fill in the data for each country.

d. Based on the information in your table, in which country is the problem of deforestation the most serious? Explain your answer. [Brazil, because it is losing its forests faster than any other country in the table, and it is also losing more forest area than any other country in the table.]

2. Study column 2 of Data Table 1. Which country had the highest percentage gain of forest and woodland? [Syrian Arab Republic, 32.2%] The highest percentage loss of forest and woodland? [Haiti, −4.8%] Given the amount of forest and woodland area in each country, how significant is the percentage? [For Syrian Arab Republic, the extremely rapid gain is significant because the country has a relatively small amount of forest and woodland area. For Haiti, the rapid loss is significant because the country has an extremely small amount of forest and woodland area.]

Thinking about the Issues

1. Industrial Country A insists that Developing Country B stop destroying its tropical forests because:

- These forests are home to millions of indigenous peoples, shelter many species of plants and animals, keep precious topsoil from eroding, and help regulate the global climate.
- They are a priceless beauty of nature that cannot be replaced.

Country B responds that:

- Country A, which used up much of its own forests to develop its economy and improve the standard of living of its people, has no right to tell Country B that it cannot do the same thing. Developing countries want to benefit from their natural resources, just as industrial countries have done from theirs.
- If Country A wants Country B to stop clearing its forests, then Country A must reimburse it for the money it will lose from not exploiting its forests.

Whose position do you support? Why?

2. A city government must decide what to do with a large parcel of undeveloped land that the city owns. The land is wooded with a river flowing through it and a railway line running along one side of it. The government has 4 options.

Option 1: Sell the land to a developer who would convert it to an industrial park and rent or sell space to businesses.

Option 2: Convert the land into a natural park with various recreational facilities. There would be an entrance fee for the park, plus additional fees for some of the facilities.

Option 3: Sell the land to a developer who would create a residential community with single- and multifamily housing, an elementary school, a recreation center, a post office, and a small shopping area.

Option 4: Create a wildlife preserve to provide habitat for diverse species, including migrating birds.

a. What kind of information must the government gather in order to choose the best option? [Possible answers: what the costs are; how much revenue could be gained; how the community feels; how the environment will be affected; whether there are zoning regulations or other constraints]

b. How would the government collect this information? [Possible answers: hold public hearings; do an environmental impact study; have experts do cost-benefit analysis; do legal research]

c. If your community faced this decision, which option would you choose and why?

3. Discuss your ideas on how people might set an economic value, or "price," on natural resources such as clean air, safe water, abundant forests, and fertile soil. Consider how you would calculate the *actual* value of using a resource (cutting timber, for example) and the *potential* value (trying to develop medicines from tropical plants, for example). How do you measure the *intangible* value of simply having the resource (enjoying a forest's beauty, or breathing clean air, or knowing that elephants exist in the wild)? How much would you yourself be willing to pay in higher prices, taxes, or donations to save tropical moist forests, protect an endangered animal, or clean up a lake or river in your community?

4. If you visit a park or recreation area, you might sometimes see fast-food containers, styrofoam cups, and other trash littered on the ground. Why do you think people litter? What can be done about it?

5. Soil degradation is less dramatic than deforestation and harder to measure, but it is a serious problem. Without a supply of fertile topsoil, people cannot survive on earth. Yet through deforestation, erosion, and poor farming practices, topsoil is disappearing. Research the facts surrounding this problem, and outline possible strategies to help conserve topsoil.

6. Over the past 25 years, food production has doubled. Ninety percent of this doubling is due to more intensive farming methods that resulted in higher crop yields; only 10 percent is the result of cultivating more land. This "intensification" will also account for most future increases in food production. But intensification can create environmental problems. Many farmers will want to use more fertilizers and pesticides, some of which will run off into rivers and lakes, endangering humans as well as wildlife. How can we maintain food production and stay healthy too?

***7.** Look again at Chart 6, which shows logging fees as a percentage of reforestation cost in 6 African countries. Research the facts to discover the situation in your country. Try to answer these questions:

a. How much of your country is covered by forests?
b. Is the amount of this land increasing or decreasing?
c. How much of this land is owned by the government?
d. Does your government allow companies to cut the trees on this land? If so, what are the logging fees?
e. How might you determine the economic, social, and environmental value of this land?

8. Research the endangered species list. Who produces it? When is an animal or plant put on the list? How many species are on the list today? Are there more or fewer species on the list than 10 years ago? How successful have efforts been to save these species?

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*For highly motivated students and those with greater knowledge of statistics and developing countries.

Name _____

Date _____

Worksheet 2: Change in Forest Area

Answer these questions in the space provided or on the back of this sheet of paper. For multiple-choice questions, circle the letter of the correct answer.

1. Define "change in forest area." [The increase or decrease in forest and woodland area during a period of time, usually one year, expressed as a percentage of that area at the start of the period.]
2. Where are most temperate forests found? [industrial countries]
3. Where are most tropical forests found? [developing countries]
4. _____ True or false: Forests are a nonrenewable resource. [false]
5. Give 3 reasons why forests are an important natural resource. [Possible answers: They enrich and hold the soil; they collect and recycle water; they help regulate climate; they absorb carbon dioxide and release oxygen; they provide lumber, food, and shelter.]
6. In the 1700s and 1800s industrial countries
   a. increased the amount of their forests by about 25 percent.
   b. decreased the amount of their forests by about 33 percent. [x]
   c. replanted about as many trees as they cut.
7. Over the past 25 years, the amount of forest and woodland has
   a. increased worldwide.
   b. stayed the same worldwide.
   c. decreased worldwide. [x]
8. During the 1980s, which region of the world lost the most forest area?
   a. Asia
   b. Latin America and the Caribbean [x]
   c. Sub-Saharan Africa
9. Give 2 reasons why people are clearing tropical moist forests so rapidly. [Possible answers: to cut timber; to set up farms and ranches; to get fuelwood; to excavate mines]
10. As a natural and economic resource, forests are often
    a. undervalued. [x]
    b. overvalued.
    c. recognized for their actual value.
11. The following percentage change in forest and woodland represents a rapid loss of trees:
    a. 3.6 percent
    b. −0.5 percent
    c. −4.8 percent [x]

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Air: Suspended Particulate Matter

(pages 6–7 of *The Environmental Data Book*)

Definition of the Indicator

Suspended particulate matter (SPM) is smoke, soot, dust, and liquid droplets from fuel combustion that are in the air. The amount of SPM reflects the quality of the air people are breathing and the state of a country's technology and pollution control.

Key Points

- Air pollution can be a problem in both rich and poor countries. Today, air pollution tends to be worse in developing countries than in industrial countries.
- The amount of data on air pollution is limited but increasing.
- Between 400 million and 700 million people—most often women and children in developing countries—suffer from indoor air pollution caused by burning biomass (wood, charcoal, dung) for cooking and heating.
- More than 1 billion people, mainly in developing countries, suffer from urban air pollution, caused largely by burning fossil fuels, especially coal and oil, for energy to generate electricity and run machines.
- Motor vehicles cause a large amount of air pollution. There are many more passenger cars in industrial countries than in developing countries, but the number of passenger cars is increasing at a much faster rate in developing countries.
- To meet their energy needs and protect the environment, many countries are seeking alternatives to fossil fuels.

Understanding the Indicator

1. Read the definition of *suspended particulate matter* (SPM) at the top of page 6 in *The Environmental Data Book*.

a. What is suspended particulate matter? [smoke, soot, dust, and liquid droplets from fuel combustion that are in the air]

b. Give examples of activities that might cause air pollution from smoke, soot, dust, or fuel combustion. [Possible answers: running vehicles; producing goods in factories; using machines; generating heating and lighting; driving on dirt roads; burning garbage]

2. To what extent do people have control over the quality of air they breathe? [to a limited extent only, unless they cooperate with each other]

3. How clean is the air you are breathing right now? Why is this the case?

Interpreting the Map

1. Study Map 3 on page 7 of *The Environmental Data Book*.

a. What is the unit of measure for the indicator? [micrograms per cubic meter of air]

b. What is the highest level of SPM shown? [300 micrograms or more] The lowest level? [99 micrograms or fewer]

c. Note that the data on the map are for cities. From these data, could you draw accurate conclusions about SPM levels throughout a particular country? Explain. [No, conditions probably vary from city to city and between urban and rural areas.]

d. Are the data for SPM plentiful or scarce? [scarce] Why do you think this might be the case? [Possible answers: Many cities and countries may not think they have a problem; others may not have enough money or trained staff to collect data.]

e. Which continent has the most data? [Asia] Which two continents have the least? [Africa and South America]
f. List all the countries that have cities with SPM levels of 300 micrograms or more. [China, India, Pakistan] On which continent are these countries located? [Asia]

2. Choose 3 countries on the map that have data for 2 or more cities. Based on these data, write a sentence describing each country. Then compare the 3 countries in 1 or 2 sentences. [Answers should discuss 3 of the following: Australia, Canada, China, India, Japan, the Philippines, the United States.]

Understanding the Text

Read the text on page 6.

1. Who is most at risk from indoor air pollution? [women and children in developing countries]

2. What causes indoor air pollution? [burning wood, charcoal, and dung for cooking and heating]

3. About how many people in the world today breathe polluted indoor air? [400 million to 700 million] How does this number compare with the population of your country? (See column 10 of Data Table 1.) [For example, it is 2 to 3 times the population of the United States, which is 250 million.]

4. What kind of energy does your family use for cooking and heating? Does using this energy pollute the air inside your home? Why or why not? Does using this energy contribute to air pollution outside your home? Why or why not?

5. How many people in cities around the world breathe unhealthy air caused by burning fossil fuels? [more than 1 billion] If the world's total population is 5.3 billion, what percentage of the world's people breathe unhealthy air? [about 20%, or 1 out of every 5 people]

6. What are some of the causes of urban air pollution? [burning coal, oil, and natural gas to run cars, factories, machines, and power stations]

7. What kinds of health problems can air pollution cause? [early death; chronic coughing, especially in children] Where do many of the people at risk live? [in developing countries, especially China and India]

8. Read about *fossil fuels* in "Definitions and Notes." What are some examples of fossil fuels? [coal, oil/petroleum, natural gas] Where do these fuels come from? [decayed animals and plants that died millions of years ago] Which fossil fuels are considered cleanest? [natural gas and higher-grade coal] Are fossil fuels a renewable resource? Explain. [No, it takes too long for them to form.]

9. What are some ways to reduce air pollution? [Possible answers: Use less energy; use cleaner ways to produce energy, goods, and services; enforce emissions standards.]

10. What are some examples of renewable sources of energy? [hydropower, geothermal energy, solar energy, wind]

11. How is the electricity for your community generated?

12. List 10 devices that you use in your daily life that require energy to run. If you had to cut the list in half in order to conserve energy and reduce pollution, which ones would you eliminate and why?

Understanding Chart 7

Study Chart 7, which shows SPM levels in cities in different country groups during different periods.

1. In general, has there been a consistent trend in urban air pollution for all country groups since the 1970s? Explain. [No, it has increased in low-income countries but decreased in middle-income and industrial countries.]

2. In the 1970s and early 1980s, which group(s) of countries had unacceptable levels of SPM? [low- and middle-income]

3. In the mid- to late 1980s, which group(s) of countries had marginally acceptable levels of SPM? [industrial]

4. Fill in the blanks in this sentence with the appropriate numbers:

"In the mid- to late 1980s, the poorest countries had roughly __[2]__ times as much urban air pollution as middle-income countries, which in turn had about __[3]__ times as much as rich countries."

5. Does the chart show the gap between rich and poor countries shrinking or widening? [widening]

6. According to the text in Chart 7, when do environmental conditions tend to improve? [when a country recognizes the value of its resources, passes laws to protect them, and has the money to deal with environmental problems]

7. Give an example from your community or country of an environmental problem that has improved and explain why.

Understanding Chart 8

Study Chart 8, which shows sources of energy.

1. What percentage of energy used in developing countries comes from biomass? [35%] Based on what you have already learned, is this biomass generally used by people in their homes or by businesses and factories? [people in their homes]

2. What are two basic ways to help reduce the health risks of using biomass? [Use it more safely, for example, by installing chimney pipes; use less of it by finding affordable alternatives.]

3. What percentage of energy in industrial countries comes from all fossil fuels combined? [85%] In developing countries? [58%]

4. From your own experience, why do people need electricity? [Possible answers: for lighting and heating; to run machines and other labor-saving devices] What are some ways that electricity is generated? [Possible answers: by burning fossil fuels, especially coal; by using water power, nuclear energy, thermal energy, solar energy] What are some ways to conserve electricity? [Possible answers: Use more efficient machines and technology; don't waste it; increase its price so people use less of it.]

Understanding Chart 9

Study Chart 9, which shows how many people there are for every passenger car in selected countries. (The term "passenger car" includes taxis, for example, but does not include trucks, buses, or vans.)

1. List the 3 countries where cars were most common in 1989. [United States, Japan, Brazil] Are these countries developing or industrial? [Brazil is developing; the others are industrial.]

2. In which country were cars the most scarce? [China]

3. Between 1970–75 and 1989, did population per car decrease faster in Mexico or Japan? (Subtract the 1989 number from the 1970–75 number. Divide the result by the 1970–75 number; multiply by 100 to get the percentage.) [Mexico, because it had a 42% decrease versus Japan's 33% decrease]

4. Developing countries have fewer cars than industrial countries but more of a problem with air pollution caused by cars. Why is this so? [The cars are often in poor mechanical condition, use leaded fuel, and are concentrated in a few cities; emission standards may not exist or may not be enforced.]

5. a. In 1990, the population of China was 1.134 billion. Assuming the same ratio of people to passenger cars as in 1989, how many cars did China have in 1990? [1,134,000,000 ÷ 4,345 = 261,000]

b. In 1990, the population of the United States was 250 million. Assuming the same ratio of people to passenger cars as in 1989, how many cars did the United States have in 1990? [250,000,000 ÷ 2 = 125,000,000]

c. How many passenger cars would China have had in 1990 if the population per passenger car were the same there as in the United States? [1,134,000,000 ÷ 2 = 567,000,000]

6. From your own experience, list 3 advantages and 3 disadvantages of motor vehicles. [Possible advantages: are quick and convenient; can travel long distances; allow freedom and privacy; can transport goods as well as people. Possible disadvantages: cause air and noise pollution; are expensive; can be dangerous; cause traffic jams; cause loss of land and habitat through road building.]

7. How important is a car in your life today? Explain your answer. What role do you think cars will play in your life 20 years from now?

8. In your opinion, does every country in the world have the right to have as many passenger cars per capita as the United States does? Explain your answer.

Using the Data Table

Study Data Table 2 on page 14 of *The Environmental Data Book*.

1.
a. On a separate sheet of paper, write the heading "High Levels of SPM." Now look at column 1 of Data Table 2. On your sheet of paper, list the 9 cities with the *highest* levels of SPM. [Beijing, Shanghai, Shenyang, Xian, Calcutta, Delhi, Jakarta, Tehran, Lahore].
b. Next to each city name, list the type of site from which the data were collected. How similar are these sites? [fairly similar: 6 are city center residential; 2 are city center commercial; 1 is suburban residential] Does this make it easier or more difficult to compare the data? Explain. [easier, because the air pollution is more likely to be caused by similar reasons, such as cooking and heating]
c. Opposite each city name, list the country in which the city is located. How many are developing countries? [all (China, India, Indonesia, Iran, Pakistan)]
d. On another sheet of paper, write the heading "Low Levels of SPM." Look again at column 1 of Data Table 2. On your sheet of paper, list the 9 cities with the *lowest* levels of SPM. [Melbourne, Brussels, Vancouver, Copenhagen, Frankfurt, Osaka, Tokyo, Fairfield (Illinois), Harris County (Pennsylvania)]
e. Next to each city name, list the type of site from which the data were collected. How similar are these sites? [fairly similar: 7 are city center commercial; 1 is suburban residential; 1 is suburban industrial] Does this make it easier or more difficult to compare the data? [easier]
f. Opposite each city name, list the country in which the city is located. How many are industrial countries? [all (Australia, Belgium, Canada, Denmark, Germany, Japan, United States]

2. Look at column 2 of Data Table 2. Note that a positive number means an increase in SPM (air quality is deteriorating). A negative number means a decrease in SPM (air quality is improving).
a. In how many of the 9 cities with the highest levels of SPM are SPM levels improving? [6] Getting worse? [3]
b. In how many of the 9 cities with the lowest levels of SPM are SPM levels improving? [7] Getting worse? [2]
c. Make a general statement summarizing the data from both groups of countries. [Possible answer: SPM pollution is declining in most cities, regardless of their levels of SPM.]

3. Read about *sulfur dioxide* in "Definitions and Notes." How is this form of air pollution generated? [by burning fossil fuels] Now look at columns 3 and 4 of Data Table 2 and do the following.
a. On a separate piece of paper, list the 9 cities with the *highest* levels of sulfur dioxide. [Beijing, Guangzhou, Shanghai, Xian, Hong Kong, Tehran, New York City, Zagreb] Which country has 5 of these cities? [China] How many of the same cities are also on your list from exercise 1(a) above? [5] In how many of the 9 cities are sulfur dioxide levels improving? [4] Getting worse? [5]
b. On a separate piece of paper, list the 9 cities with the *lowest* levels of sulfur dioxide. [Melbourne, Montreal, Toronto, Vancouver, Helsinki, Bombay, Tokyo, Bangkok, Houston] Which country has 3 of these cities? [Canada] How many of the same cities are also on your list from exercise 1(d) above? [3] In how many of the 9 cities are sulfur dioxide levels improving? [7] Getting worse? [2]
c. Make a general statement summarizing the data from both groups of countries. [Possible answer: Sulfur dioxide pollution is declining in cities with the lowest levels but getting worse in cities with the highest levels.]

Thinking about the Issues

1. Look again at Chart 8. Research the 6 sources of energy listed in the chart to find out which are nonrenewable. [oil, coal, natural gas] Report your findings to the class.

2. You are the president of a large middle-income country. Over the past 25 years the country's economy has grown rapidly, and so has its population. Today, 35 million of the country's 80 million people live in urban areas. As a result, the cities face many problems. Massive traffic jams clog the streets, and excessive demand for energy has already caused numerous electricity blackouts. The quality of the air is so bad that many people are frequently ill. Something must be done. Citizens' groups, health groups, business organizations, and environmentalists are all demanding action. Your advisers have presented you with a set of options. You must choose 5 of them and convince your country's parliament to work with you to put them into action. Which 5 options would you choose? Put a check mark next to each one and explain your decision.

___ a. Put a tax on gasoline that increases the price per gallon by 75 percent.
___ b. Give tax breaks and other incentives to industries to encourage them to move their factories out of the urban areas and into the countryside.
___ c. Ban private motor vehicles permanently from city centers.
___ d. Organize a public awareness campaign to encourage people to conserve energy.
___ e. Raise income taxes by 6 percent and use the extra income to fund research on low-polluting electric cars.
___ f. Double the price of electricity.
___ g. Build a rapid transit system in the capital; expand the public bus service in all large cities; charge inexpensive fares for these services.
___ h. Give tax incentives to industries to help them modernize their factories and introduce cleaner production technologies.
___ i. Provide free health workshops to teach people how to protect themselves and their families from pollution.
___ j. Toughen air pollution emissions standards and enforce harsh penalties for offenders.

3. Because of higher gasoline taxes, gasoline prices are several times more expensive in Europe and Japan than they are in most developing countries and in the United States. Why do you think gas taxes are lower in developing countries and the United States? [Possible answers: Affordable energy helps the economy to grow; pressure from voters who want don't want to spend more money than they have to; people feel that energy is abundant and that everyone has a right to it.] What are the advantages and disadvantages of increasing these taxes? [Possible advantages: People will use less energy, so there will be less pollution; people will use energy more efficiently, so less energy will be wasted; the government will get more tax revenue, so it can spend more on cleaning up the environment; energy reserves will be used up more slowly. Possible disadvantages: People with smaller incomes will be less able to afford cars; citizens may get angry and vote for someone else; businesses may grow more slowly.]

4. Who owns the air? Who is responsible for keeping it clean? In recent times several crises around the world have caused people and governments to realize that air quality problems do not respect boundaries. Research one or more of the crises listed below. Try to answer these questions: What happened? How many people were at risk? Were other countries affected? Who was responsible for the problem? How was the problem solved? How can the same type of problem be prevented from occurring again?

- the toxic gas leaks that killed thousands of people in Bhopal, India, in 1984
- the 1986 nuclear accident in the city of Chernobyl in the former USSR
- the eruption of Mount Pinatubo in the Philippines in 1991
- the oil fires in Kuwait at the end of the Gulf War in 1991

***5.** In the 1950s and 1960s nuclear power was promoted as the energy source of the future. But today many experts predict it will not be widely used. Research the history of nuclear power and the arguments for and against its use.

*For highly motivated students and those with greater knowledge of statistics and developing countries.

6. You are an executive with an automobile manufacturing company. You and the other executives are meeting to decide how to use the $30 million profit the company made in the past year. You know that the public is becoming more concerned about the environment, and you expect the government to tighten factory emissions standards in 2 years, vehicle emissions standards in 3 years, and gas mileage performance standards in 5 years. Several proposals have been put "on the table" for consideration at the meeting. They include:

a. Continue to split the profits 50–50 between the stockholders and reinvestment in the company for the usual replacement of worn-out equipment and for standard research and development. It may be years before the government takes a firm stand on environmental issues. In the meantime, it makes good business sense for the company to focus on increasing its profits and better serving its stockholders.

b. Put 40 percent of the profits into research and development specifically for cleaner-running, more efficient cars. In this way, the company will be ready when the government imposes stricter regulations. Split the rest of the profits between shareholders and the company as outlined in Option (a) above.

c. Put all the profits into (1) new factory equipment that pollutes less and uses less energy; (2) research and development targeted specifically toward cleaner, more fuel-efficient cars; and (3) systems to clean up industrial wastes created during the production process. This is a sound investment in the future of the company, which should reassure stockholders. It is also good public relations for the company, which will sell more cars.

Which proposal do you support, or do you have an alternative plan? Prepare a speech to convince your colleagues to vote with you.

Name _____

Date _____

Worksheet 3: Suspended Particulate Matter

Answer these questions in the space provided or on the back of this sheet of paper. For multiple-choice questions, circle the letter of the correct answer.

1. What is suspended particulate matter? [smoke, soot, dust, and liquid droplets from fuel combustion that are in the air]

2. Do levels of SPM tend to be higher in developing countries or in industrial countries? [developing countries] Why? [These countries are using more and more energy as their economies grow, but they often do not yet have the money or expertise to deal with environmental problems.]

3. About how many people worldwide breathe polluted air inside their homes?
   a. 40 million to 70 million
   b. 400 million to 700 million [x]
   c. 1 billion

4. The people most affected by indoor air pollution are
   a. women and children. [x]
   b. women and men.
   c. women.

5. About how many people in cities worldwide breathe polluted air?
   a. 1 billion [x]
   b. 2 billion
   c. 3 billion

6. What are 2 major sources of air pollution? [burning biomass, burning fossil fuels]

7. Why do people burn fossil fuels? [to get energy]

8. What are 3 ways to help reduce air pollution? [Possible answers: Use fossil fuels more efficiently; use cleaner sources of energy; limit the use of cars and trucks; increase energy prices; enforce emissions standards; use cleaner technologies to produce energy, goods, and services; make and enforce laws to protect the air.]

9. a. Are passenger cars more common in industrial countries or developing countries? [industrial countries]
   b. Is the number of passenger cars increasing more rapidly in industrial countries or developing countries? [developing countries]

10. a. Are data on air pollution plentiful? [no]
    b. Do the data focus on rural or urban areas? [urban] Why? [That's where the largest concentration of people live and where the problem is more acute.]

Atmosphere: Carbon Dioxide Emissions per Capita

(pages 8–9 of *The Environmental Data Book*)

Definition of the Indicator

Carbon dioxide (CO_2) emissions per capita are measured as the tons of carbon a country releases into the atmosphere during a period of time, usually one year, divided by its total population. They reflect how industrialized a country is and how much energy its people consume.

Key Points

- Carbon dioxide, a greenhouse gas, accounts for the largest share of the global warming effect that is linked to human activity.
- Most of this CO_2 is released into the atmosphere when countries burn fossil fuels, especially coal.
- CO_2 emissions per capita tend to be much higher in industrial countries than in developing countries. For example, in 1989 CO_2 emissions per capita in the United States were almost 10 times those in China.
- The extent to which increasing emissions of CO_2 and other greenhouse gases will raise average temperatures on earth remains unclear.
- Greenhouse gas emissions can be decreased by generating and using energy more efficiently, using cleaner production technologies, pricing energy to reflect the real costs of supply, and using more renewable sources of energy.
- In the future, developing countries will use more and more energy as they develop their economies, but their per capita energy use will remain low because of their growing populations. At the same time, industrial countries with relatively small populations will continue to use large amounts of energy.

Understanding the Indicator

1. Read the definition of *carbon dioxide emissions per capita* at the top of page 8 in *The Environmental Data Book*.

a. What is the unit of measure used to quantify CO_2 emissions per capita? [tons of carbon]

b. What do CO_2 emissions per capita tell you about a country? [how industrialized it is and how much energy its people consume]

c. From your own experience, give some examples of what people use energy for. [Possible answers: to run their cars, televisions, lights, furnaces, air conditioners, factories]

2. Fill in column 3 of the table below. (Divide each country's CO_2 emissions by its population.)

Country	(1) CO_2 emissions (tons of carbon)	(2) Population	(3) CO_2 emissions per capita (tons of carbon)
A	127,710,000	27,000,000	[4.73]
B	178,500,000	850,000,000	[0.21]
C	57,000,000	150,000,000	[0.38]

The countries in the table are in North America, Asia, and South America. Refer to columns 6 and 10 in Data Table 1 in *The Environmental Data Book* and identify the countries. [Canada, India, Brazil]

3. If a country's total CO_2 emissions remain the same and its population increases, will its CO_2 emissions per capita increase or decrease? Explain. [decrease, because if there are more people, each must emit less to keep total emissions from increasing]

Interpreting the Map

Study Map 4 on page 9.

1. a. What color represents countries with the lowest levels of CO_2 emissions per capita? [dark green] On which continents do these countries tend to be located? [Africa, Asia, South America]

b. What assumptions might you make about living conditions in these countries [Possible answers: Their economies are probably not highly industrialized; there are probably few cars, machines, factories, and other devices that require large amounts of energy to run; people's standard of living may not be high.]

c. What color on the map represents countries with the highest levels of CO_2 emissions per capita? [yellow] On which continents do these countries tend to be located? [Australia, Europe, North America]

d. What assumptions might you make about living conditions in these countries? [Possible answers: Their economies are industrialized; there are probably many cars, machines, factories, and other devices that require large amounts of energy to run; people's standard of living is probably high, with many goods and services.]

2. Name 2 countries in North and Central America and the Caribbean, 2 in Europe, 2 in the Middle East and North Africa, and 1 in Asia and the Pacific where, on average, people are emitting 3.1 tons or more of carbon into the atmosphere. [North and Central America and the Caribbean (any 2): Canada, Trinidad and Tobago, United States. Europe (any 2): Bulgaria, former Czechoslovakia, Poland, former USSR (Belarus, Russian Federation). The Middle East and North Africa (any 2): Kuwait, Saudi Arabia, United Arab Emirates. Asia and the Pacific (any 1): Australia, Singapore]

Understanding the Text

Read the text on pages 8–9.

1. Read about *greenhouse gases* in "Definitions and Notes." What is a greenhouse gas? [a gas that traps solar heat within the earth's atmosphere]

2. Does burning fossil fuels or burning forests account for more accumulation of carbon dioxide in the atmosphere? [burning fossil fuels]

3. Read the definition of *Celsius* in "Definitions and Notes." Calculate the Fahrenheit equivalent of 4.5 degrees Celsius. [8.1°F]

4. Are scientists certain about how carbon dioxide and other greenhouse gases caused by human activity will affect the environment? [no] What are some possible consequences? [temperature increase; rise in sea level; flooding; damage to ecosystems and agricultural land] Why do you think countries with stronger, more diverse economies would tend to be hurt less by these consequences? [Possible answer: because they have more money, greater flexibility, and more options for dealing with the changes] How could these consequences affect the way you live?

5. Read the definition of *meter* in "Definitions and Notes." Calculate the equivalent of 0.7 meters in inches. [about 27.6 inches]

6. What are 2 strategies countries might use to help reduce their emissions of greenhouse gases? [Possible answers: Use cleaner production technologies; increase energy prices; use less fossil fuel.]

7. In what ways could you as an individual decrease the amount of energy you consume and thus help decrease the amount of CO_2 being released into the atmosphere? [Possible answers: Turn off lights and other electrical devices when not in use; recycle paper, plastics, glass; walk more, drive less.]

Understanding Chart 10

Study Chart 10, which shows carbon dioxide emissions per capita for different countries in 1989.

1. Which 2 countries had the highest CO_2 emissions per capita? [United States, Canada] The lowest? [India, Brazil]

2. Find these 4 countries on Map 4 on page 9. On which continent is each country? [The United States and Canada are in North America; India is in Asia; Brazil is in South America.] How does each country's CO_2 emissions per capita compare with those of its neighbors? [Canada emits the same as its neighbor, the United States; the United States emits the same as Canada but more than Mexico; India emits the same as its neighbors; Brazil emits about the same as its neighbors.]

3. Based on its CO_2 emissions per capita (5.37 tons of carbon) and its total population, how many tons of carbon did the United States release into the atmosphere in 1989? [249,000,000 people × 5.37 tons of carbon per person = 1,337,130,000 tons of carbon]

4. If CO_2 emissions per capita in China had been the same as those in the United States, how many tons of carbon would China have released into the atmosphere in 1989? [1,100,000,000 people × 5.37 tons per person = 5,907,000,000] How many times larger is this amount than the amount emitted by the United States? [4½]

Understanding Chart 11

Study Chart 11, which shows total and per capita energy consumption for 1970–2030 in developing and industrial countries.
[*Note*: Teachers may want to point out that total consumption is measured in *millions* of barrels of oil equivalent per *day*, while per capita consumption is measured in *barrels* of oil equivalent per *year*. Explain that this shows a difference in *scale*: what one person consumes during a whole year is much less than what the total population consumes in one day.]

1. Note that the chart shows *commercial* energy consumption. Look up *energy use per capita* in "Definitions and Notes." What kind of energy is not included in commercial energy? [energy from biomass]

2. In 1990, what was the average per capita energy consumption in industrial countries? [40 barrels of oil equivalent] In developing countries? [about 3½ barrels]

3. Based on the chart, what happens to total energy consumption in developing countries between 1970–2030? [It increases.]

4. What happens to per capita energy consumption in industrial countries? [It increases until 2000, then decreases.]

5. In the year 2000, the average person in industrial countries will use about how many times more energy than the average person in developing countries? [8 times more]

6. In developing countries, why does per capita energy consumption stay relatively low even though total energy consumption rises rapidly? [Population is growing rapidly too, so although the country is consuming more energy, that energy must be divided among more people.]

7. In what ways might people suffer if everyone in the world consumed as much energy as the average individual in an industrial country? In what ways might they benefit? [Problems might include more pollution and loss of natural resources. Benefits might include more cars, machines, and other labor-saving devices for people worldwide.]

8. In your opinion, is Chart 11 too optimistic when it assumes that in the future, countries will use energy more efficiently? Explain.

Understanding Chart 12

Study Chart 12, which shows how much CO_2 countries could emit if they had emission quotas based on population size. (A quota is a limit on the amount of something.)
[*Note:* The total quota for global CO_2 emissions has been defined as 2 times the level of CO_2 that was estimated to have been in the earth's atmosphere at the beginning of the Industrial Revolution.]

1. Which group of countries has the largest quota? [low-income] The smallest quota? [industrial and high-income developing]

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2. Based on the chart, in which group of countries do most of the world's people live? [low-income] Where do the fewest live? [industrial and high-income developing countries] How do you know this? [by the size of the quotas, which are based on population size]

3. Complete these sentences by circling the correct choice in each pair of words in parentheses:

"Chart 12 shows that the richest countries have emitted (more / less) than their fair share of CO_2. The poorest countries have emitted the (most / least) CO_2. Middle-income countries have emitted about (one-third / 3 times) as much as they are entitled to." [more; least; one-third]

4. Do you believe that every person on earth has an equal right to the atmosphere? Do you think each individual in the world has the right to emit the same amount of CO_2? Explain.

5. What if countries agreed to sell their emission rights? If rights to emit CO_2 were sold at $25 per ton of carbon, industrial countries would have to pay developing countries about $70 billion to afford a year's emissions at 1988 levels. Such a sum roughly matches the total amount of development assistance that rich countries gave poor countries in 1989.

a. Do you think this idea of selling emission rights is a good one? Explain.

b. Based on this model, calculate how much money each country in the table below would have paid in 1989. (Multiply CO_2 emissions per capita by the population and multiply the result by $25.) Write your answers in column 3.

Country	(1) CO_2 emissions per capita, 1989 (tons of carbon	(2) Population, 1989	(3) Cost of buying emission rights (dollars)
United States	5.37	249,000,000	[$33,428,250,000 or $33.4 billion]
Brazil	0.38	147,000,000	[$1,396,500,000 or about $1.4 billion]

Using the Data Table

[The blank comparative data table at the back of this book may be photocopied for these exercises.]

1. Make a table comparing the 5 countries with the highest CO_2 emissions per capita. Get a blank comparative data table and title it: "Countries with High CO_2 Emissions per Capita." Use columns 5, 6, and 10 of Data Table 1. Follow these steps.

a. At the top of column 1 of your table, write "CO_2 emissions per capita, 1989 (tons of carbon)." At the top of column 2, write "Energy use per capita, 1990 (kilograms of oil equivalent)." At the top of column 3, write "GNP per capita, 1990 (US dollars)."

b. In the first square on the left of your table, under the heading "Country," list the country with the highest CO_2 emissions per capita in 1989. [United Arab Emirates] Fill in the CO_2 emissions data, the 1990 energy use, and the 1990 GNP per capita data for this country.

c. Continuing down the left of your table, list the 4 countries with the next highest CO_2 emissions. [United States, Canada, Kuwait, Australia] Fill in the data for these countries in columns 1, 2, and 3.

d. Find these 5 countries on Map 4 on page 9. Which are industrial countries, and in which regions are they located? [The United States and Canada are in North and Central America and the Caribbean; Australia is in Asia and the Pacific.] Which are developing countries, and in which regions are they located? [Kuwait and the United Arab Emirates are in the Middle East and North Africa.]

2. Make another table comparing the 8 countries with the *lowest* CO_2 emissions per capita. Get a blank comparative data table and title it: "Countries with Low CO_2 Emissions per Capita." Use columns 5, 6, and 10 of Data Table 1. Follow these steps.

a. At the top of column 1 of your table, write "CO_2 emissions per capita, 1989 (tons of carbon)." At the top of column 2, write "Energy use per capita, 1990 (kilograms of oil equivalent)." At the top of column 3, write "GNP per capita, 1990 (US dollars)."

b. Down the left side of your table, list the 8 countries with the lowest CO_2 emissions per capita in 1989. Then fill in the emissions data, 1990 energy use data, and the 1990 GNP per capita data for these countries.

c. Find these 8 countries on Map 4 on page 9. Which are developing countries and in which regions are they located? [All are developing countries. Bhutan and Nepal are in Asia and the Pacific. Burundi, Chad, Ethiopia, Mali, Rwanda, and Uganda are in Sub-Saharan Africa.]

3. Look at the two tables you created for exercises 1 and 2 above.

a. Among the countries with *high* CO_2 emissions (the first table), what are the ranges of data (that is, the highest and lowest numbers in each column)? What are the ranges for the countries with *low* emissions (the second table)? In general, how do the numbers for the two groups of countries compare? [Countries with high CO_2 emissions emit hundreds of times more CO_2 per capita, use hundreds of times more energy per capita, and have up to 100 times more GNP per capita.]

b. What relationship do you see between a country's per capita CO_2 emissions, energy use, and GNP? [There is a positive correlation: when one indicator is high, the others tend to be high; when one indicator is low, the others tend to be low.]

c. What might explain why 2 of the top 5 emitters of CO_2 are developing countries, even though high emissions are associated with industrialized countries? [Kuwait and the United Arab Emirates are *high-income* developing countries, and high income tends to mean high emissions.]

4. Read about CFCs *(chlorofluorocarbons)* and CFC *use* in "Definitions and Notes."

a. Look at column 7 in Data Table 1, which shows the increase of CFCs in the atmosphere. List the 5 countries responsible for the largest increase. [United States, Japan, Germany, Italy, United Kingdom]

b. Which, if any, of these 5 countries is also among the 5 countries with the highest CO_2 emissions per capita (listed in the table you created in exercise 1 above)? [United States]

c. How many countries were responsible for no increase in CFCs? [64]

d. In a sentence or 2, describe the trends that the data show. [The world's richest countries are responsible for increasing levels of CFCs in the atmosphere.]

Thinking about the Issues

1. The world's rich and poor countries are participating in an international meeting to discuss reducing CFC emissions. The current debate concerns refrigerators. A primary health care goal of the developing countries is to ensure that all households have access to a refrigerator, to help prevent illness from eating spoiled food. In the past, a source of CFCs has been the coolant in refrigerators, but a new refrigerator now exists that uses significantly fewer CFCs. Although the developing countries are concerned about the global environment, they cannot afford to buy the safer refrigerators. They argue that rich countries created the high CFC levels, and poor countries should not have to make sacrifices to solve the problem. They have presented what they say is a fair solution: have industrial countries pay the difference in price between the 2 types of refrigerators.

a. Do you think the industrial countries will agree to this solution? Explain your answer.

b. Which group would you support? Why?

***2.** Read about *acid rain* in "Definitions and Notes." Research the answers to the following questions. What causes acid rain? What are its consequences? How can the problem of acid rain be solved?

3. Research how energy is generated in your country. Discuss the advantages and disadvantages of the different methods. [Possible answers: Burning coal is less expensive but it pollutes the air. Nuclear power is abundant but it can be dangerous and create hazardous wastes. Water power is not so dangerous but it may mean damming rivers, flooding land, and relocating people.]

***4.** Discuss what you think the government's role should be in regulating the price, supply, and distribution of energy in your country.

*For highly motivated students and those with greater knowledge of statistics and developing countries.

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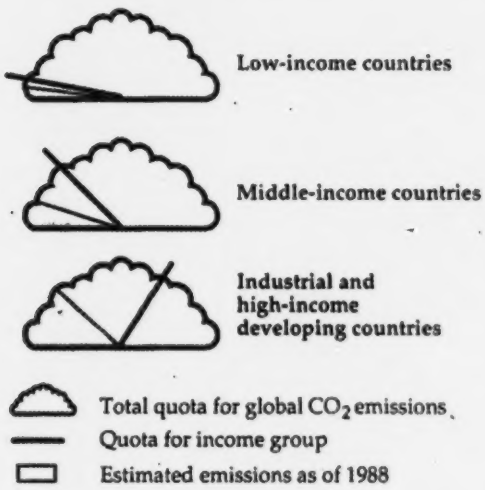
5. Look again at Chart 12. What if the right to emit CO_2 were based not on population size but on wealth? Study the diagrams below to see what this scenario would look like.

What If the Right to Emit Carbon Dioxide Were Based on Wealth?


Low-income countries
Middle-income countries
Industrial and high-income developing countries
Total quota for global CO_2 emissions
Quota for income group
Estimated emissions as of 1988

a. Which country group would have the largest emission quota? [industrial countries and high-income developing countries] The smallest? [low-income countries]
b. Study actual emissions and the emission quotas for each country group. Which country groups, if any, are under their emission quotas? [all of them] Which country group has the largest quota left for the future? [industrial countries and high-income developing countries] The smallest quota left? [low-income countries]
c. If countries agreed to sell their emission rights, which country group(s) would probably want to buy? [low- and middle-income] Which could least afford to buy? [low-income]
d. Which system do you think is fairer—emission quotas by population or by wealth? Explain your answer.

6. Some experts do not agree that global warming is actually occurring, nor do they agree on what its possible consequences might be. Given this uncertainty, what course of action do you think the world—developing countries, industrial countries, environmental groups, political organizations, and others—should take, and why?

a. Continue researching, but wait to act until more is known.
b. Continue researching, but take some preventative measures, at modest cost, to gradually stabilize CO_2 emissions.
c. Continue researching, but take immediate action, at high cost, to reduce output of all greenhouse gases.
d. Other.

Name _____

Date _____

Worksheet 4: CO_2 Emissions per Capita

Answer these questions in the space provided or on the back of this sheet of paper. For multiple-choice questions, circle the letter of the correct answer.

1. Define CO_2 emissions per capita. [the tons of carbon a country releases into the atmosphere during a period of time, usually one year, divided by its total population]

2. Calculate CO_2 emissions per capita for a country whose total emissions are 71,740,000 tons of carbon and whose population is 17 million. [4.22 tons of carbon per capita]

3. What do CO_2 emissions indicate about a country? [how industrialized it is and how much energy its people use]

4. CO_2 emissions per capita in industrial countries tend to be
   a. lower than in developing countries.
   b. higher than in developing countries. [x]
   c. about the same as in developing countries.

5. What are 2 ways to help decrease CO_2 emissions and other greenhouse gases? [Accept any 2: Find substitute energy sources for fossil fuels, especially coal; don't waste energy; use cleaner more efficient ways to produce goods and services; set energy prices higher to reflect their true value.]

6. _____ True or false: Carbon dioxide, a greenhouse gas, accounts for the largest share of the global warming effect that is linked to human activity. [true]

7. What human activity accounts for most of the CO_2 released into the atmosphere? [burning fossil fuels, especially coal]

8. In the future, developing countries will use
   a. more energy. [x]
   b. less energy.
   c. about the same amount of energy.

9. If a country's CO_2 emissions remain the same and its population increases, its CO_2 emissions per capita will
   a. increase.
   b. decrease. [x]
   c. stay the same.

10. What are some possible effects of high levels of carbon dioxide and other greenhouse gases on the earth's environment? [temperature increase; rise in sea level; flooding; damage to ecosystems and agricultural land]

Culminating Activities

Questions for Discussion

1. Look again at the cover of *The Environmental Data Book*. What are the 4 categories into which the information has been organized? [water, land, air, atmosphere] Why do you think the information was divided up in this way? [Possible answer: When you break down information, it is easier to understand.]

2. What are the 4 basic economic development and environment problems introduced in this book? [lack of access to safe water, loss of forests, suspended particulate matter and air pollution, carbon dioxide emissions and atmospheric pollution]

3. What other problems and issues could each of the 4 units have examined? [Possible answers: Water—costs and benefits of dam and irrigation projects; dumping raw sewage, chemical wastes, and other pollutants into rivers, lakes, and oceans; oil spills, offshore oil drilling; pesticides and fertilizers in drinking water; loss of wetlands and damage to coastal areas and reefs; overuse of water resources and water shortages; waterborne disease. Land—erosion, loss of topsoil, pesticides in soil; loss of biodiversity and habitat; logging and mining; sustainable agriculture; land use policies; overcrowded landfills; disposal of solid wastes and hazardous wastes. Air—other kinds of air pollution, including carbon monoxide and nitrogen oxides; pesticides sprayed aerially; alternative energy sources. Atmosphere—ozone depletion; using cleaner technologies; acid rain.]

4. Think about the problems and issues you listed to answer questions 2 and 3 above. Give examples of how some of them are connected. [For example, erosion may mean that insecticides and pesticides are draining into the supply of drinking water. Oil spills at sea may cause loss of habitat on land. Burning fossil fuels can both increase air pollution and contribute to possible climate change.]

5. Before you began studying *The Environmental Data Book*, what did you consider to be the 3 most serious environmental problems facing people today? How would you answer that same question now? Have your ideas changed?

6. The world's population is growing at the rate of 1.7 percent—about 93 million people—every year. Ninety percent of these people will live in developing countries, mostly in urban areas. What challenges does rapid population growth pose for the environment? How will the challenges be different for people in urban and rural areas? [Answers should note that there will be more loss of natural habitats and more pressure on existing resources. The need to feed a growing population and provide more timber, oil, and other goods will mean more intensive farming, logging, mining, and fishing in rural areas and thus more risk of deforestation, soil degradation, overgrazing, and overuse of water resources. The growth of cities will mean more crowding, expanded transport, more industry, and higher energy use, leading to greater problems of sanitation, polluted water, and air and atmospheric pollution.]

7. The government of a low-income country in Asia has decided to build a large dam in the countryside to provide irrigation water to farmers and to generate more electricity for the capital city. What might be some advantages and disadvantages—environmental and economic—of this dam for people living in the countryside and in the capital city? [Advantages: The land will become more productive and farmers will be able to grow more crops; more people in the capital city will have electricity in their homes; businesses will be able to produce more. Disadvantages: Agricultural and forest land may be lost, plant and animal habitats destroyed, and people displaced; pollution in the capital city may increase, and the government, taxpayers, and businesses will have to pay to clean it up.]

8. Imagine time has passed and you are now 25 years old. What 3 statements would you like to be able to make about environmental conditions in your country?

9. Many of the environmental problems introduced in *The Environmental Data Book* affect people who live in poverty more than others. Why is this the case? [Poor people often do not have the income, education, or information to improve their living conditions.]

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10. Who should pay to clean up the environment? Some people argue it should be the polluters who are responsible for the problems. Others say it should be governments because they have the necessary money, expertise, and authority. What do you think?

11. Some people argue that industrial countries use more than their fair share of natural resources. Other people say that the issue is not how much a country consumes, but how much pollution and environmental degradation the country causes. What do you think?

Research Activities

1. Research and report on the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in June 1992. What was it? What were its outcomes? What will its impact be?

2. As a class activity, conduct a survey to see how the news media cover environmental issues. Divide into groups and have each group choose a newspaper to read or a television news program to watch for a week. Keep notes on the environmental stories that are presented, and then analyze your findings. How many stories were reported during the week? What issues were covered? Were they of local, national, or international interest? How much column space or air time was devoted to them? Were they the lead stories, or did they run at the back of the paper or late in the broadcast? Were they treated as news items, features, or editorials? How did coverage differ among the news sources you examined? Overall, do you think the news media pay too much, too little, or about the right amount of attention to environmental concerns?

3. Research a developing country's efforts to find solutions to an environmental problem. Possible subjects include Costa Rica's policies to protect its forests, Indonesia's program to preserve wetlands, Israel's use of solar energy, Kenya's efforts to save wildlife, or Poland's attempts to curb air pollution. How successful have these measures been? Are there lessons for other countries with similar problems?

***4.** Choose a developing country from Data Table 1. Find out what natural resources the country has and what the standard of living is for people there. Draw up an "Environment and Development Action Plan" for the country designed to help the economy grow, to improve living conditions for the poorest people, and to protect the environment.

***5.** Research shows that educating women and girls may be the key to solving environmental and development problems. Why might this be the case?

6. Research your community's recycling activities. Find out what items are recycled, how they are collected, what happens to them, how much recycling costs, and how much revenue it generates. If your community does not have a recycling program, develop a proposal for one. Be sure to explain how the program would work, what its costs and benefits would be, and how you would convince citizens to support it.

Topics for Debate

1. *Resolved:* That every individual in the world has an equal right to use the earth's natural resources to improve his or her standard of living.

2. *Resolved:* That economic development in developing countries can help to protect the environment.

3. *Resolved:* That sovereign nations have the right to use their natural resources and develop their economies in the way they see fit.

*For highly motivated students and those with greater knowledge of statistics and developing countries.

Name _____

Date _____

Test: *The Environmental Data Book*

Part One [This part is worth 17 points. Give 1 point for each correct answer.]

Circle the letter of the phrase that correctly completes each sentence below.

1. Of the world's more than 5 billion people, the number who do not have access to safe water is approximately
   a. 1 billion. [x]
   b. 2 billion.
   c. 2 million.

2. Most of these people live in
   a. industrial countries.
   b. industrial and developing countries.
   c. developing countries. [x]

3. The percentage of people in a country who have access to safe water is affected by
   a. population growth.
   b. the country's economy.
   c. health conditions.
   d. all of the above. [x]

4. When people get access to a supply of safe water and can practice good hygiene, life expectancy tends to
   a. increase. [x]
   b. decrease.
   c. stay the same.

5. Since 1980, overall access to adequate sanitation in developing countries has
   a. increased. [x]
   b. decreased.
   c. stayed the same.

6. Since 1965, the amount of forest and woodland worldwide has
   a. increased.
   b. decreased. [x]
   c. stayed the same.

7. During the 1980s, the region of the world that lost the most forest area was
   a. Asia.
   b. Latin America and the Caribbean. [x]
   c. Sub-Saharan Africa.

8. Two examples of renewable resources are
   a. fossil fuels and solar energy.
   b. water and minerals.
   c. forests and air. [x]

9. Most of the 400 million to 700 million people in the world today who are at risk from indoor air pollution are
   a. men and women in industrial countries.
   b. children in developing countries.
   c. women and children in developing countries. [x]

10. Indoor air pollution is caused by burning
    a. oil for heating.
    b. dung, charcoal, and wood. [x]
    c. gas for cooking.

11. Today the primary source of energy for industry is
    a. fossil fuels. [x]
    b. biomass.
    c. the sun.

12. Since the 1970s, urban air pollution has
    a. decreased in both industrial and developing countries.
    b. increased in the poorest countries but decreased in other countries. [x]
    c. increased in the richest countries but decreased in other countries.

13. Most urban air pollution is caused by burning
    a. coal and oil. [x]
    b. coal and wood.
    c. coal and natural gas.

14. In urban areas worldwide, the number of people who breathe unhealthy air caused by burning fossil fuels is more than
    a. 1 billion. [x]
    b. 2 billion.
    c. 2 million.

15. As suspended particulate matter increases, air pollution
    a. decreases.
    b. increases. [x]
    c. stays the same.

16. Carbon dioxide emissions per capita tend to be highest in
    a. low-income countries.
    b. middle-income countries.
    c. industrial countries. [x]

17. As a country's energy use per capita increases, its carbon dioxide emissions per capita tend to
    a. increase. [x]
    b. decrease.
    c. decrease, then increase.

Part Two [This part is worth 5 points. Give 1 point for each correct answer.]

Indicate whether each of the following statistics would be considered high (H), medium (M), or low (L) for a country. Write the appropriate letters in the blanks.

1. [L] Thirty-six percent of the population has access to safe water.
2. [H] The country lost 4.8 percent of its forests last year.
3. [H] Population per passenger car is 2.
4. [L] SPM levels in urban areas are 35 micrograms per cubic meter of air.
5. [H] Annual average carbon dioxide emissions per capita are 5.37 tons of carbon.

Part Three [This part is worth 24 points. Give 1 point for each correct letter and 1 point for each correct number.]

The table below gives statistics for 2 countries. Answer the questions that follow. In the spaces provided, write the letter for the appropriate country and the number (or numbers) from 1 to 11 that indicate which statistic (or statistics) support your choice. In some cases, more than one type of statistic will be needed. Use scratch paper if you need to make calculations.

Statistic	*Country A*	*Country B*
1. GNP per capita	$2,490	$350
2. Population	86,000,000 people	850,000,000 people
3. Access to safe water	70%	22.5%
4. Change in forest and woodland	−1.2% per year	−0.2% per year
5. Forest and woodland area	430,000,000 sq. km.	667,360,000 sq. km.
6. Population per passenger car	15 people	553 people
7. Energy use per capita	1,300 kg. of oil equivalent	231 kg. of oil equivalent
8. Carbon dioxide emissions per capita	1.01 tons of carbon	0.21 tons of carbon
9. Increase in CFC use	5,000 metric tons	0 metric tons
10. Average population growth rate	2.0% per year	2.1% per year
11. Percentage of population in urban areas	73%	27%

1. Which country will add a greater number of people to its population next year?
   Country [B] Statistic(s) [2, 10]
2. Which country uses 6 times more energy per capita than the other?
   Country [A] Statistic(s) [7]
3. In which country is it easier for people to get safe water?
   Country [A] Statistic(s) [3]
4. Which country has a greater number of people living in urban areas?
   Country [B] Statistic(s) [2, 11]
5. Which country is losing more forest area?
   Country [A] Statistic(s) [4, 5]

6. In which country is urban air more likely to be polluted by exhaust fumes from motor vehicles?
   Country [A] Statistic(s) [6]
7. In which country do people have access to fewer goods and services?
   Country [B] Statistic(s) [1]
8. Which country burns more fossil fuels?
   Country [A] Statistic(s) [8]
9. Which country emits a greater total amount of carbon dioxide?
   Country [B] Statistic(s) [2, 8]
10. Which country is losing its forests faster ?
    Country [A] Statistic(s) [4]

Part Four [Each question is worth 20 points.]

1. Chitra, a teenage girl, and Kumar, a teenage boy, live with their family in a low-income country in Asia. Write an essay in which you
   a. describe 3 environmental problems that might affect their lives
   b. explain why these problems exist
   c. discuss how these problems are different from or similar to the environmental problems people in your country face.

   [A good essay will include environmental problems such as indoor and urban air pollution; lack of safe water and sanitation systems; and the loss of forests, topsoil, and other natural resources. Reasons for these problems would include lack of emission standards and other government laws and policies, inefficient technology, rapid population growth, rapid urbanization, and the fact that people and countries are too poor or lack the expertise to improve the situation. Students may say that people in their country, too, worry about air and water pollution, but those problems pose bigger health threats to Chitra and Kumar. Students may also mention that heavy energy consumption and high greenhouse gas emissions are more of a problem in their country than in Chitra and Kumar's.]

2. Based on what you have learned in *The Environmental Data Book*, describe the 2 environmental problems that you think are the most serious and explain your choices. Discuss why these problems exist, whether they are improving or worsening, and how to solve them. Use statistics to support your position.

   [A good essay will demonstrate an understanding of the scope and impact of an environmental problem: how many people are affected, where they live, how quickly conditions are changing, what the consequences will be for future generations if no action is taken, and what action could be taken.]

   [There are 86 total points on the test.]

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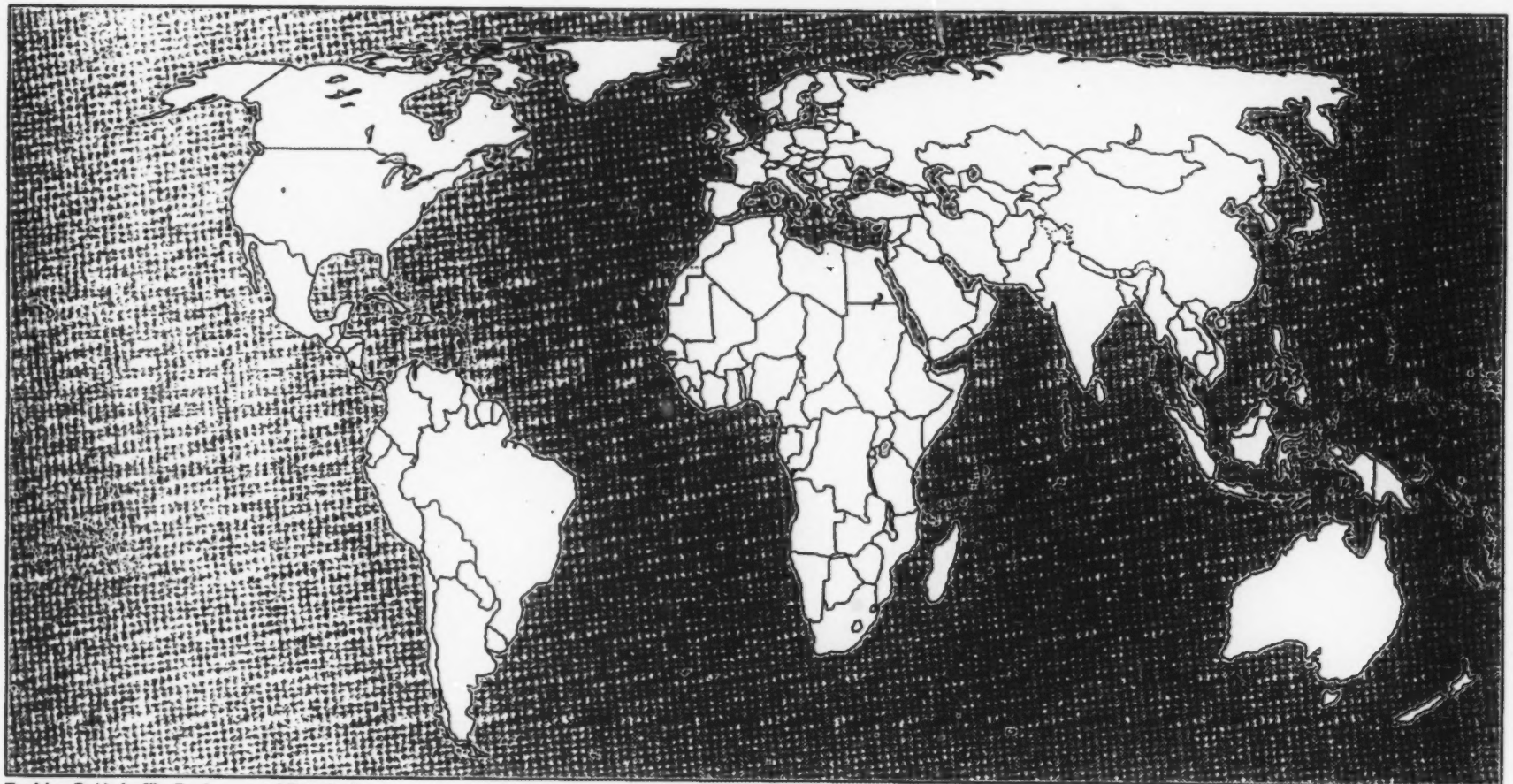

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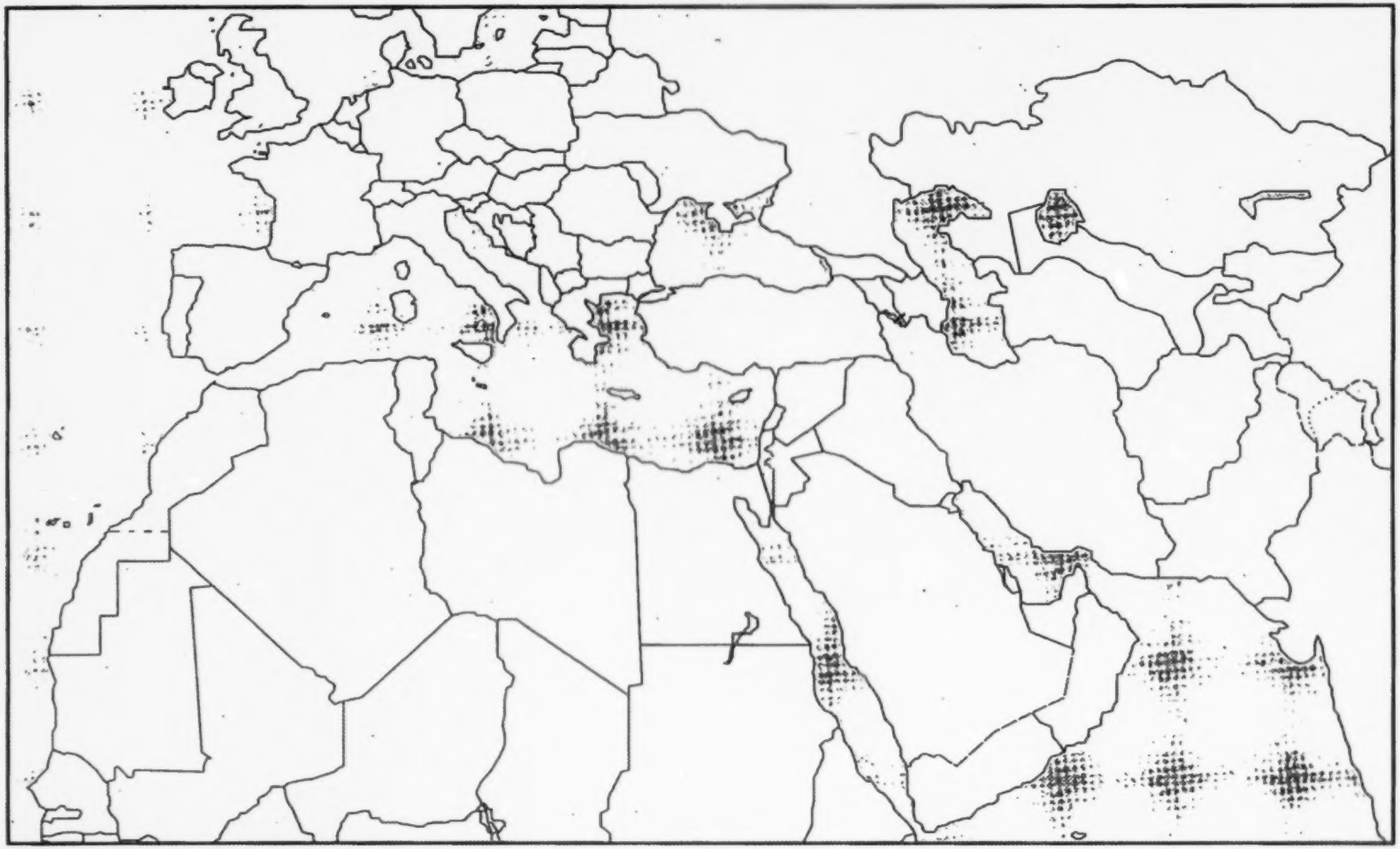

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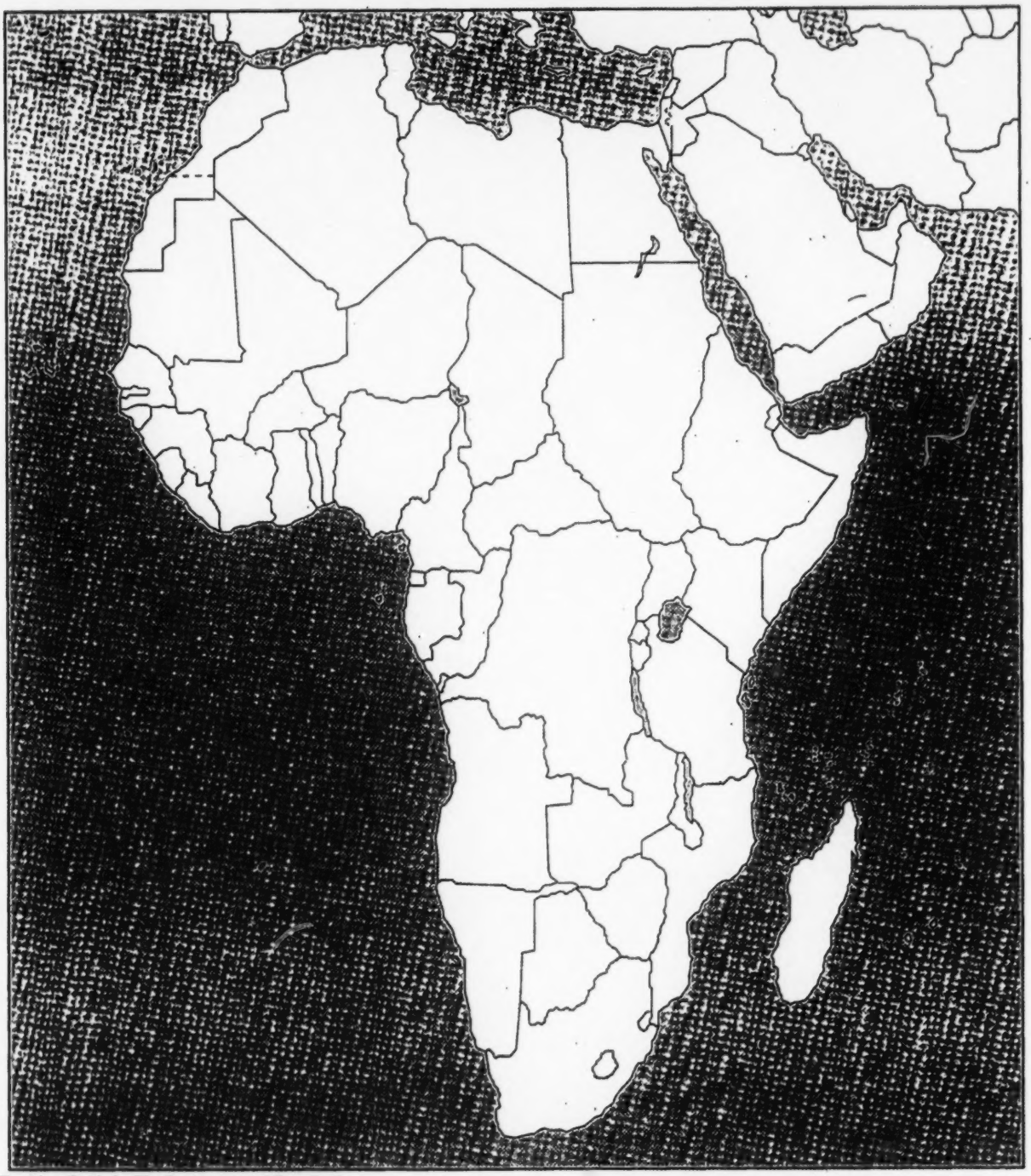

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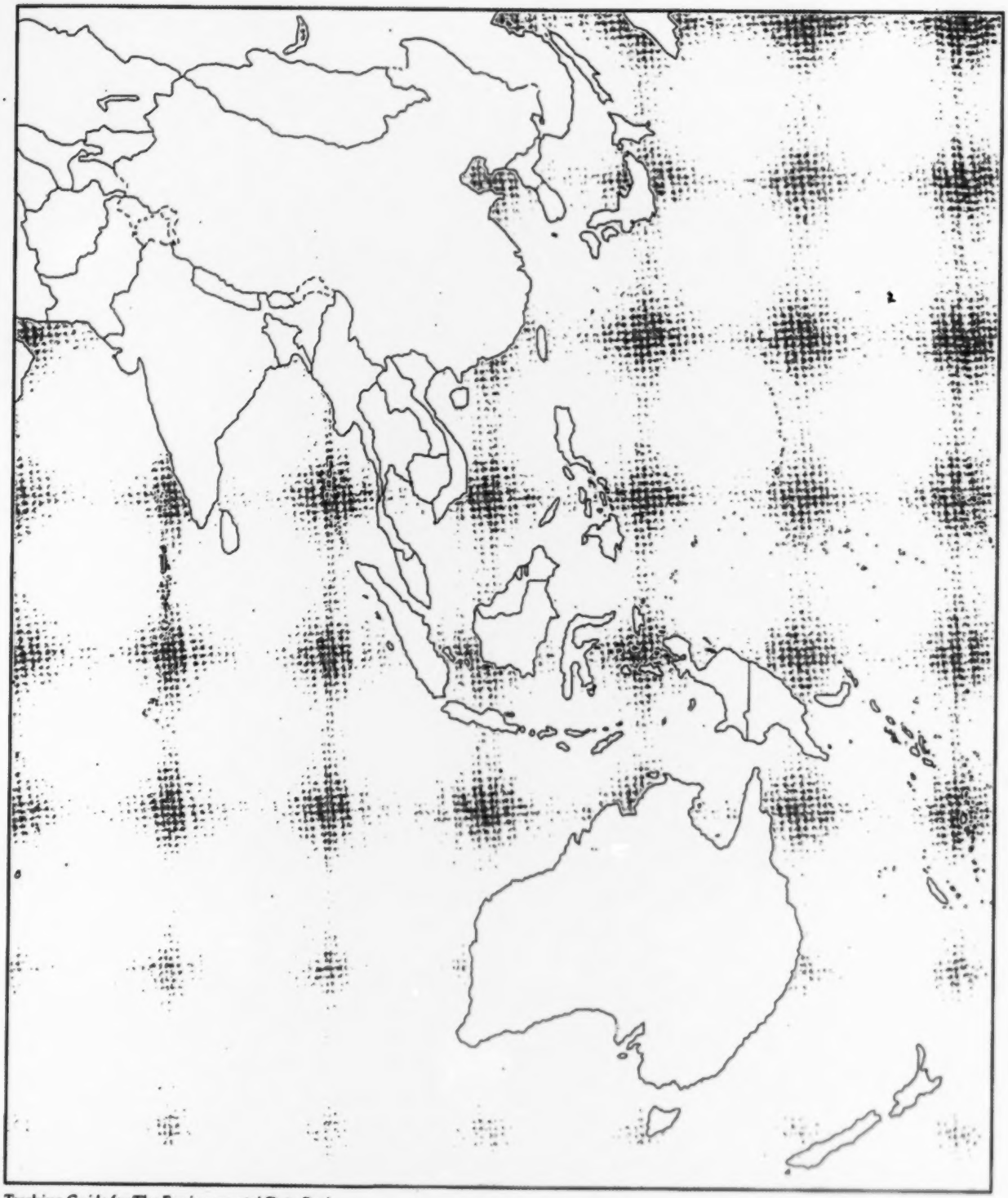

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Title: _____

Country	(1)	(2)	(3)	(4)	(5)

Comparative data table for the *Teaching Guide for The Environmental Data Book*
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Notes

Notes

This teaching guide for *The Environmental Data Book* was written by Katherine Sheram and edited by Kathryn Kline Dahl. Esther Riley helped prepare activities for the first unit, "Water: Access to Safe Water." The cover and layout were designed by Walt Rosenquist. The maps were generated by Jeffrey Lecksell and are based on the Eckert IV equal-area projection.

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